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THESIS

Management of Joint Service Acquisition: An Analysis of the Joint Unmanned Aerial Vehicles Program

by

Michael E. Hogan

December 1992

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In an era of declining defense budgets, the DOD must revise it's modernization strategy if it is to continue to field world class equipment. One viable alternative strategy is to combine funds and effort whenever possible through the use of joint service acquisition programs. However, the Services have been reluctant in the past to initiate joint Service programs and will probably continue to be reluctant in the future unless certain changes are made to the acquisition process. This thesis examines the Unmanned Aerial Vehicles (UAV) program and identifies issues through a series of interviews with key Government individuals within the UAV Short Range (SR) program office and the UAV Joint Program Office (JPO), as well as with representatives of the users within the Army and Marine Corps. Comments received during the interviews were used in conjunction with program documentation to formulate issues which impact the UAV-SR program and are a direct result of the joint status of the program. The issues identified are not all currently problem areas for the UAV-SR, but they have the potential to become problem areas. The recommendations made in this thesis are specific to the UAV-SR but may also be applicable to other joint Service acquisition programs as well.

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Management of Joint Service Acquisition: An Analysis of the Joint Unmanned Aerial Vehicles Program

by

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Submitted in partial fulfillment
of the requirements for the degree of

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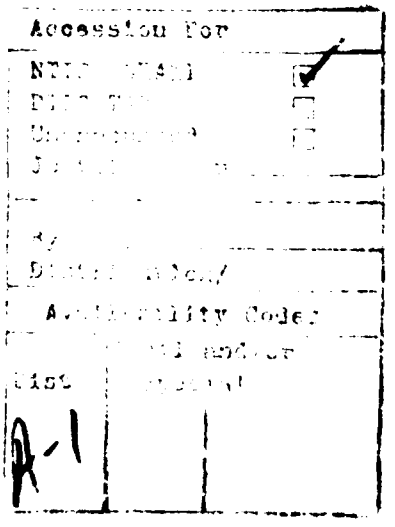
ABSTRACT

In an era of declining defense budgets, the DOD must revise its modernization strategy if it is to continue to field world class equipment. One viable alternative strategy is to combine funds and effort whenever possible through the use of joint service acquisition programs. However, the Services have been reluctant in the past to initiate joint service programs and will probably continue to be reluctant in the future unless certain changes are made to the acquisition process. This thesis examines the Unmanned Aerial Vehicles (UAV) program and identifies issues through a series of interviews with key Government individuals within the UAV Short Range (SR) program office and the UAV Joint Program Office (JPO), as well as with representatives of the users within the Army and Marine Corps. Comments received during the interviews were used in conjunction with program documentation to formulate issues which impact the UAV-SR program and are a direct result of the joint status of the program. The issues identified are not all currently problem areas for the UAV-SR, but they have the potential to become problem areas. The recommendations made in this thesis are specific to the UAV-SR and may also be applicable to other joint service acquisition programs in general.



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I also want to acknowledge the assistance of Captain Tom Hoivik, USN (Ret), who provided me the guidance and push to finish this thesis in a timely manner.

Finally, to my wife Suzanne and two children, Jack and Michael-Anne, I want to express my greatest appreciation for their patience and support through the last several months. The kids learned the meaning of the word "Thesis" at an age much earlier than should be required.

I. INTRODUCTION

A. PURPOSE

The purpose of this thesis is to analyze joint service acquisition programs and to determine how these types of programs may be of greater use to the Department of Defense (DOD) in the future. This thesis is a case study of the Unmanned Aerial Vehicles (UAV) program and, while the conclusions will be specific as they apply to the UAV, some of the lessons learned and insights may also be applicable to joint service programs in general.

B. BACKGROUND

The United States has been the world leader in weapons technology since the end of World War II. Victory in the Cold War and in the Persian Gulf are the most recent examples of the successful union of the military and the industrial capabilities of the U.S. Much of the success the United States enjoyed in Operation Desert Storm can be attributed to the superior weaponry that it had built and fielded in the years prior to the conflict. The pace at which the U.S. modernized its military, especially during the 1980s, also contributed to the dissolution of the Eastern Bloc. However, the fact that the U.S. already possesses the world's best weapons, along with the fall of the Soviet Union, has created a perception amongst some that modernization may no longer be critical for the military. Certainly, the threat to peace has diminished, but, for the military to maintain its leadership role in the world it must continue its modernization strategy.

The apparent collapse of communism brought not only a renewed sense of

security to the world but also a change in priorities for the American public. The focus shifted from foreign policy to the domestic situation and first on the agenda was a major decrease in the defense budget. As of the current date, the exact size of the decrease is not known, however, it is expected that a one-third reduction is possible.

The challenge for DOD now is to equip the soldiers, sailors and marines with world class equipment in a period of drastically reduced defense budgets. DOD must find ways to spend its acquisition funds more wisely. One method of maximizing research and development and procurement funds is to utilize a strategy of sharing resources between the Services. Thus, the role of joint service acquisition programs within DOD may be expected to increase in the future.

Acquisition programs are usually not joint from their inception and few programs become joint without some initiative by OSD or the Congress. Joint service acquisition programs are normally instituted for operational and/or economic reasons. Coordination and interoperability between the Services is usually enhanced if common systems are used. Additionally, Research, Development, Test and Evaluation (RDT&E) costs are reduced when these efforts are consolidated and total system costs can also be lower if larger quantities of systems are procured. Today, joint programs are strongly supported and encouraged by OSD and Congress. [Ref. 1]

In the present acquisition climate, however, the Services must lead the way in becoming more efficient in the research, development and procurement arenas if they wish to continue to field new systems with fewer funds. One viable alternative is for the Services to look for more opportunities to combine effort and funds for systems which can be jointly procured and used by more than one

Service. In fact, DOD Directive 5000.1, "Defense Acquisition," states that prior to the initiation of a new acquisition program a full range of alternatives must be considered. In considering the alternatives, a new joint-Service program is preferred over a new single-Service program. [Ref 2]

For the DOD to fully utilize the benefits of joint service acquisition programs, though, the barriers and issues which have hindered these types of programs in the past must be identified and resolved.

C. THESIS OBJECTIVE

The objective of this thesis is to identify the problems and issues involved in the management of joint service acquisition programs. Although joint programs have been utilized throughout our nation's history, they have not been used to the extent that they could. There have been many more opportunities to have joint service acquisitions but they have been limited because of a myriad of reasons, not the least of which has been interservice rivalries. The focus of this thesis will be the UAV, a program that appears to have been ideally suited for a joint status from the beginning, but was not. The Services had individual UAV programs which were subsequently plagued by problems until DOD was directed by Congress to initiate a joint program or all funding for UAVs would stop. The joint program now appears to be a success.

This thesis will identify some of the issues involved with the management of the Joint UAV program. It will attempt to offer plausible recommendations to alleviate the impact of these issues on future joint programs. It will analyze the UAV program from its conceptual development and progress as individual Service programs, through the creation of the joint program, and developments in the

program up to the present. The thesis will examine the effectiveness of current policies for the management of joint service programs and how these policies are implemented in the UAV program. Additionally, the benefits of sharing costs and resources in the development of a joint system will be analyzed. The problem areas and recommendations for improvement identified through this thesis will hopefully be of use to the UAV Joint Program Office (JPO) as well as to the DOD acquisition structure.

D. RESEARCH QUESTIONS

1. Primary Research Question

What are the major issues involved in the management of joint Service programs?

2. Subsidiary Research Questions

a) What is DOD's current policy for the Management of Joint Service Programs?

b) Is there enough similarity among the single Service UAV programs to warrant a joint Service program?

c) What lessons can been learned from the UAV Joint Program?

d) What are the actual benefits of the joint status as experienced within the UAV JPO?

e) What recommended changes to the current acquisition policy would encourage the establishment of more joint service programs and contribute to a greater likelihood of their success?

E. RESEARCH SCOPE AND LIMITATIONS

A detailed analysis of all DOD Joint Service Programs is beyond the scope of this thesis. Rather, this thesis will examine the acquisition climate during a specific time frame and with a specific program. This thesis will identify the DOD policies affecting joint programs from the initiation of the Unmanned Aerial Vehicles program up to the present.

This thesis is limited to the policies and procedures as they are currently implemented. The acquisition field within DOD is currently undergoing major changes and revisions and it is virtually impossible to include the absolute latest material in all areas. Therefore, proposed changes and drafts to regulations and directives will not routinely be referenced.

Recommendations and comments will be made as they pertain to the UAV JPO and joint programs in general. This thesis is a case study of a specific program and, as such, the conclusions will be specific as they apply to the UAV program and general as they apply to other joint programs.

F. RESEARCH METHODOLOGY

The background and policy information was obtained from written sources. The history of the UAV programs from the Army and Navy are well-documented in program documents, congressional records and news publications which were all used. The Joint Logistics Commanders Guide for the Management of Joint Service Programs published by the Defense Systems Management College served as the principal source of officially prescribed policies and procedures. The analysis and evaluation of the UAV JPO was partially the result of extensive interviews with key Government individuals assigned to the Short Range

program offices as well other key agencies. The questions during the interviews varied dependent on each individual's position within the program and their particular areas of expertise. However, each person was asked to state his perception of the advantages and disadvantages of joint programs versus single Service programs. Additionally, the program office provided the UAV Master Plan and many other program documents as reference material.

II. JOINT SERVICE AQUISITION

A. BACKGROUND OF DEFENSE ACQUISITION

The United States Department of Defense is the largest and most complex business organization in the world. It is responsible for developing and producing the most advanced weaponry in history. From its inception though, the military has never been fully independent of the private sector in meeting its war material needs. The armed forces have always relied on private enterprise to supply the material, equipment, and services needed in peace and war. Before and during World War II, the defense industry was concerned primarily with simplicity, reliability, and producibility. Industry quickly responded to the needs of the military and the process was noted for its relative efficiency. After the 1950s, however, the industry became one of custom design and development and DOD oversight began to play a major role. When the Department of Defense was established in 1947, the Secretary of Defense was limited to providing general direction to the three military departments and, therefore, had no authority to implement a formal DOD acquisition policy. Each Service was responsible for the development and procurement of its own systems, independent of the other Services.

The Office of the Secretary of Defense (OSD) did, however, publish a very general document in 1947 which covered business operations between industry and DOD. The document was called the Armed Services Procurement Regulation and numbered 125 pages. In 1958, the Department of Defense Reorganization Act greatly expanded the role of the Defense Secretary and gave him the authority to assign the development, production, and operational use of weapon

systems to any military department or Service. [Ref 3] Thus began an era of ever increasing oversight by OSD in the defense acquisition process. In 1984, the Federal Acquisition Regulation (FAR), the primary set of regulations for all Federal executive agencies relating to Federal procurement, was published. These regulations numbered 1,200 pages. Military procurement was fast becoming a major economic entity within the country and congressional oversight and regulation was growing rapidly. There presently exists volumes upon volumes of regulations and policy statements which relate to defense acquisition, all of which make the process more complex and expensive.

During the decade of the 1980s, nearly $130 billion was spent each year on defense research and development and on production of weapon systems and equipment. In one year alone, more than one hundred major defense systems were in various stages of development and production. A major weapon system being defined as not only the major end item itself, such as a tank or aircraft, but also all of the subsystems, logistical support, training and software that are needed to operate and support it. As the programs became more technologically advanced and complex the costs began to skyrocket. Weapons procurement became synonymous with cost overruns and schedule delays in the eyes of Congress and the American public.

B. JOINT PROGRAMS AS A VIABLE STRATEGY

In 1961, newly appointed Secretary of Defense Robert McNamara was instructed by President Kennedy to develop the force structure necessary to meet the military requirements at the lowest possible cost. McNamara had been a very successful businessman and had risen to the top of Ford Motor Company prior to

his appointment as Secretary of Defense. From the outset, he was concerned with cost overruns in the development of weapon systems and set out to upgrade the effectiveness and efficiency in the Defense Establishment. [Ref. 4]

The Defense Reorganization Act granted OSD a greater role in DOD procurement and McNamara fully intended to better control military spending. When he learned that the Air Force and the Navy both had plans for new tactical fighters he intervened. Since the two planes would have many common missions and require similar capabilities he directed the two Services to jointly develop a new common tactical fighter. The TFX (tactical fighter, experimental) was later designated the F-111 and was to replace the Air Force F-105 and the Navy F-4H aircraft. At the time, each Service was in the process of developing its own aircraft independently and Mr. McNamara was convinced that a single fighter would save at least $1 billion. The Navy and Air Force were opposed to a common tactical fighter and did as little as possible to cooperate in the joint venture. Interservice bickering over the operational requirements, technical specifications and even the management structure led to congressional interference and eventually to the program's demise. [Ref 5]

Few of the critics argued about the benefits that the concept of a joint aircraft would have provided. The advantages would have included savings in development, production, maintenance, and operating costs as well as in logistical support. The two Services' RDT&E funds could have been consolidated to save the costs of efforts which were being duplicated in the two separate programs. Also, a larger procurement of a single aircraft would have resulted in lower unit costs and a more efficient logistics system. Had the budget constraints of today been present during Mr. McNamara's term, the outcome of the program may have

been different. Although the TFX failed as a joint service program, Mr. McNamara's efforts contributed greatly to laying the foundation which would make joint service acquisition a viable alternative strategy in future military procurements.

C. MANAGEMENT OF JOINT SERVICE PROGRAMS

The following discussion of the management of joint service acquisition programs concentrates on the differences between single service programs and joint service programs. The primary source for the "official" policies and procedures for the management of joint service programs is the Joint Logistics Commanders Guide for the Management of Joint Service Programs, 3rd Edition, published by the Defense Systems Management College in 1987. [Ref 6] DOD guidance for joint programs is limited to very general policies and procedures as outlined in the recently updated 5000 series publications. DOD Instruction 5000.2, Part 12, Section B, contains three pages of instructions for the management of joint acquisition programs.

1. Establishing Joint Programs

Joint programs can and should be established between two or more Services whenever a similar need or requirement exists. However, the Services in the past have been reluctant to establish joint programs because of questions concerning Service unique operational concepts, performance specifications, configuration constraints and management structure. In an effort to promote and facilitate the establishment of joint programs, the Joint Requirements Oversight Council (JROC) was created in 1984 under the auspices of the Joint Chiefs of

Staff (JCS). The members of the JROC include the Vice Chiefs of Staff of the Air Force and Army, the Vice Chief of Naval Operations, the Assistant Commandant of the Marine Corps, and the Director of the Joint Staff. The chairmanship is rotated among the Services. The primary responsibilities of the JROC are to: examine potential joint military requirements; identify, evaluate and select candidates for joint programs; provide oversight of cross-service requirements and management issues; and resolve Service issues that arise after a joint program is initiated. The JROC issued a Memorandum for the Record in 1986 which stated the generally accepted benefits of joint programs and instructed each Service to implement procedures whereby programs requirements are reviewed by the Services themselves to specifically determine the potential for inter-Service programs. Each Service is responsible for assigning a joint potential designator to each new research and development (R&D) program which has been approved for initiation. The designation will be one of the following:

a. Independent. There is no potential for other Service use or joint systems development.

b. Interoperating. Joint program management is inappropriate but a potential for joint operation or joint systems interface exists.

c. Joint. A potential for joint R&D program management and/or joint procurement exists.

If a common or related set of requirements exists among two or more Services and these requirements could be most cost effectively achieved through a joint program, then the participants are required to negotiate specific roles, activities and responsibilities. Once a program has been identified as having joint potential, a "lead or executive Service" is designated to assume the authority and

responsibility for managing the joint program. The lead Service will assign a program manager (PM), initiate the program charter, and act as the coordinator of interservice relationships. A joint program may fall into one of a variety of categories that have evolved over the years as represented in Table I. The lead Service should have total program funding authority and responsibility with the other participating Services responsible for any Service unique efforts, changes and procurements. The Joint Program Charter is one of the most important documents in the early stages of program initiation. The Charter should state the program objective, define the PM's authority, specify funding and resource responsibilities, identify the chain of command and designate the program office organization.

Finally, the establishment of a joint program must include the delineation of the needs of all participating Services into a specific requirements statement. The General Accounting Office (GAO) has stated that getting agreement on joint requirements has been the greatest problem in joint acquisition programs [Ref. 7]. Ideally, the Mission Need Statement (MNS) will serve as the requirements document and will be approved by all Services prior to a program initiation. However, in most cases a joint program is created by merging two or more existing single-Service programs. In either case, the statement of operational requirements (the MNS or Operational Requirements Document [ORD]) must satisfy the operational needs of all participating Services without unduly compromising individual Service needs. The tendency has been for each Service to overstate or over-specify requirements to ensure that its needs are met Compromise and trade-offs should be recognized as an essential element of the

TABLE I. JOINT PROGRAM CATEGORIES

Program Category		Characteristics
S	See S-1 to S-5 below	
S-2	Single-service Manager / Executive Agent	Single-service program; interest from other services manifested by their consumption or use of end product; all program direction and funding has single source
S-3	Single-service PMO with Point of Contact	Single-service program; interest from other services manifested by their designation of a service point of contact (POC) for maintaining liaison
S-4	Single-service PMO with On-Site Liaison	Single-service program; interest from other service(s) manifested by their assignment of a full-time (POC) liaison officer
S-5	Single-service PMO with Senior Representative	Single-service program; representative(s) from other service(s) assigned to PMO; all authority and responsibility to program manager stems from parent service; no formal coordination of requirements, charter, etc
S-6	Fully Integrated Joint Program Office (JPO)	Multiservice participation;integrated JPO; staffed by all participating services;directed by program manager assigned by lead service. Participating services may perform some program functions but on behalf of JPO, not for separate service program. MODEL JPO
M-1	Lead-Service Coordinated Programs	Programs exist in more than one service;one service PMO provides coordination among all programs. Executive authority does not reside with coordinating PMO
M-2	OSD Directed Programs	More than one service has program in the technical discipline. A lead service is not assigned. The objectives of the programs may not be the same. Direction, coordination and or standardization is executed not through a designated lead service, but by OSD, either directly or through a PMO established for the purpose and reporting, not to a military service acquisition commander, but the OSD
M-3	Confederated Programs	More than one service has at least one program in the generic technical area and the end products of which are used in allied but separate warfare areas. The PMOs characteristically share technical information and development data
M-4	Single service Requirement-Other Service Tasking	Single-service has specific requirement, but acknowledging that another service has preeminent capability or interest in execution of a part of the program objective, arranges for that segment to be executed by the other service

Note: A Program Designator Code of S-1 denotes a single-service program and accordingly is not included in the table.

(Source: Guide for the Management of Joint Service Programs;p. 1-2)

process by all participants and cooperation on the part of the Services in this regard will contribute greatly to the program's overall success. [Ref. 6:pp. 2-1 - 2-7]

2. Acquisition Strategy

Once a joint acquisition program has been established, the PM must determine the acquisition strategy. An acquisition strategy is considered the overall plan for executing the program whereas the acquisition plan is the activity oriented means of achieving the strategy. The acquisition strategy defines the interrelationship between management, technical, business, resource, force structure, support, testing, and other aspects of the program. It must be kept current throughout the life of the program and address management issues from development to production that assess the impact of: 1) different levels of funding; 2) problems in testing; 3) changes in requirements; 4) control of engineering changes; 5) length of product maturation; and 6) effects of lead time. The Army, Navy, and Air Force each address acquisition planning and strategy development in slightly different ways. In the Army, Acquisition Strategy and Acquisition Plan are two separate documents. In the Navy, the Acquisition Plan satisfies the Acquisition Strategy requirements and in the Air Force the two are synonymous. Likewise, the Services address slightly different acquisition strategy elements when formulating single-Service acquisition issues. The following ten issues should be considered in the joint environment:

Issue 1 - Competition

Issue 2 - Concurrency/Time Phasing

Issue 3 - Data Rights

Issue 4 - Design-to-Cost

Issue 5 - Incentives

Issue 6 - Make-or-Buy

Issue 7 - Multiyear Contracting

Issue 8 - Phased Acquisition

Issue 9 - Pre-planned Product Improvement

Issue 10 - Source Selection

While most of the ten acquisition issues addressed are common to all Services, some may be prioritized differently or may be more difficult to implement because of a joint status. Concurrency, or the overlapping of tasks or phases in the acquisition cycle, may be more difficult in a joint program because problems in testing of all participants compatibility requirements may arise or one Service may be slow in granting approval to move to the next stage. Conversely, concurrency may be more prevalent in a joint program to the point of being detrimental if it exists out of necessity to meet schedule requirements and is not adequately managed. An example may be a requirement by one Service to test all interoperability requirements, even in the early developmental stages, which might lead to attempts to solve difficult problems before all of the minor ones are satisfied. In the Design-to-Cost (DTC) issue, the Army requires that DTC be implemented on software programs of $40 million or more and the other Services have no such requirement. The need to satisfy all Service-unique regulations may further complicate the management of joint service programs and increase overall program costs. The acquisition strategy for a joint program can certainly be more complex than a single-service program but it can be successful if it is tailored and

modifiable and addresses the ten acquisition issues. Joint service programs should also be recognized as different and problems with conflicting regulations and requirements should be resolved by the participants. [Ref. 6:pp. 4-1 - 4-19]

3. Organization and Staffing

There is no standard organization for a joint program. The organization may be one of a wide variety depending on the size and goals of the program, the acquisition strategy, the role of OSD and JCS, and the relationship among the participating Services. Joint programs normally require more personnel than single-service programs due to the greater need for coordination. They generally require more diverse skills and specialties in the joint program office to handle the increased complexities of a joint acquisition. The rank structure tends to be higher as well because of the increased responsibilities and the need to be knowledgeable of the other Services' operations. A higher ranking person may also better represent the needs of his Service. The staff is also larger because it must maintain larger volumes of records, conduct additional budget activities, and prepare separate briefings to the participating Services. A joint service program is usually structured under one of the following three methods:

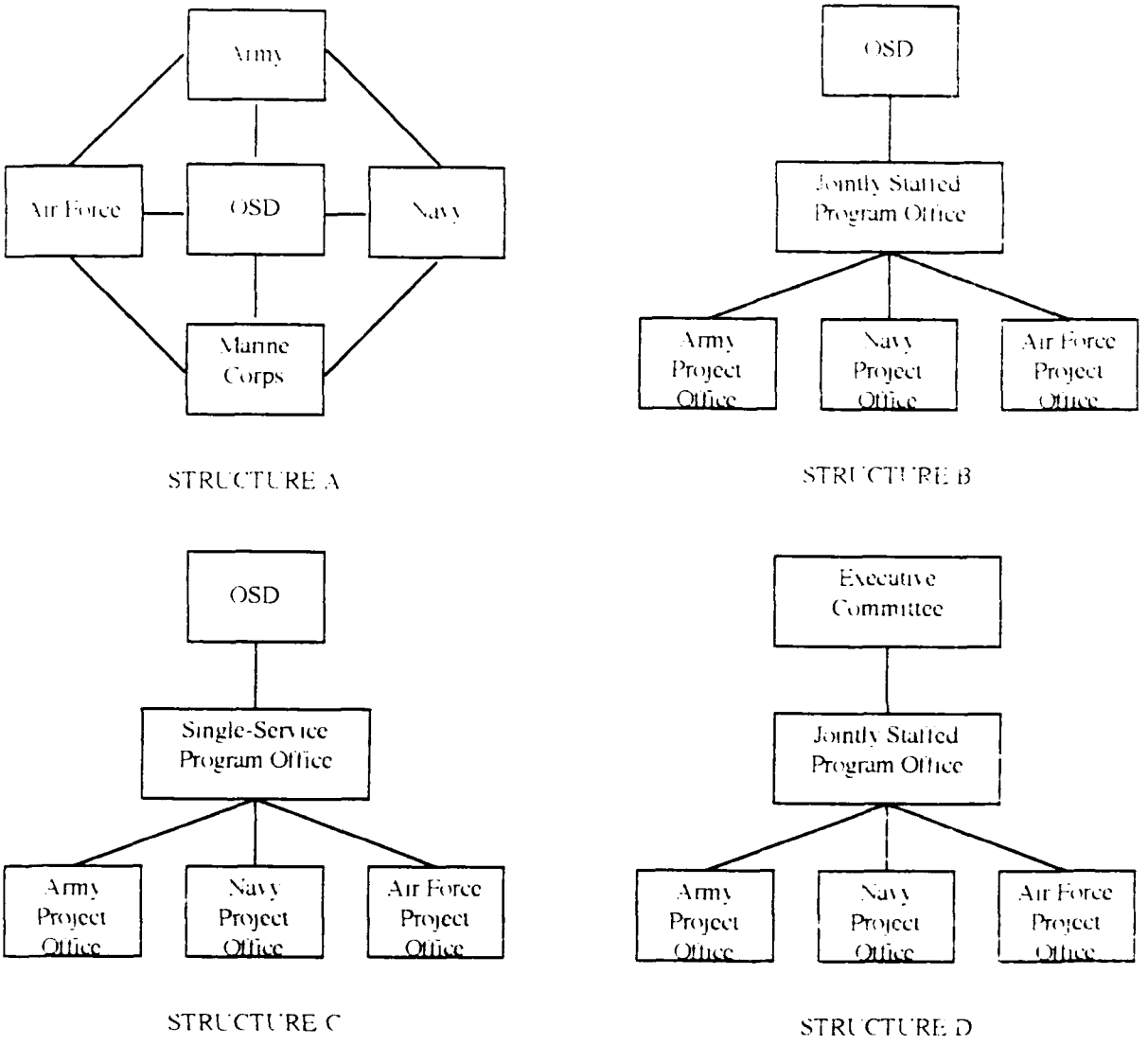
a. Normal Joint Service Program Offices. For the most part, these programs are structured and managed as a single-service program. The participating Service may assign a liaison or it may simply monitor the program. Normally, the interests of the lead Service dominates.

b. Jointly Staffed Program Offices. The lead Service provides the PM, most of the program management staff, and administrative support.

Participating Services provide a deputy PM and other military officers to the program management staff.

c. Multiple Program Offices. These are multiple programs whose activities are coordinated. The degree and method of coordination vary from program to program. Frequently, OSD plays a direct role in the program's execution. Four examples of these structures are depicted in Figure 1. In Structure A, each Service manages its own program but exchanges information regularly with the other Services. OSD may divide responsibilities among the Services to eliminate duplication of effort. In Structure B, a jointly staffed OSD program office is created and OSD directs the program. In Structure C, one of the Services provides overall program management. In Structure D, program direction is provided by an executive committee.

Program office staffing of joint programs usually follows the organization practice of the lead Service. The Army tends to use matrix organizations where functional support is brought into the program to supplement a cadre of managers. The Navy and Air Force tend to use self-contained program offices especially in high-priority programs. In both cases, the joint program office should ensure that staff members from participating Services have a proper allocation of key positions to maintain a balance within the program office. Some challenges for the PM in a joint program office include properly and fairly evaluating officers from the participating Services and developing esprit de corps within the program office. [Ref. 6:pp. 6-1 - 6-6]



(Source: Guide for the Management of Joint Service Programs:p. 6-3)

Figure 1 Structures of Joint Programs Having Multiple Program Offices

4. Engineering, Production, and Software Management

The three areas of management: engineering, production, and software, are vital to the success of any major acquisition program. Engineering management involves the process of transforming an operational need into a description of system performance parameters and a system configuration including all hardware and embedded software requirements. The joint program manager must be concerned with the multitude of Service directives, instructions, regulations, orders, and military standards (MIL-STD) which will impact his program. There currently is an effort to streamline standards and specifications by the Services, but the PM must be aware of all of the applicable MIL-STDs the participating Services are using. The other key area of concern for the PM is in design changes. Changes to system requirements will inevitably lead to changes in the system design which may bring about a virtually new program. The painstaking effort required to obtain a consensus on the original system requirements by all of the participants will have to be repeated every time a design change is implemented.

Production management includes the evaluation of production criteria prior to the decision to produce, and subsequently monitoring the production effort to ensure that it is efficient and effective. DOD directives and instructions should be followed in this area and are fairly uniform between the Services.

Software management involves the design, development and testing of all of the embedded software within the system. The joint program manager must ensure that the potential for interservicing of software is reviewed and that all software support options are fully analyzed. The PM must work closely with all

using and developing activities to ensure that the resulting software fulfills its designated requirements. [Ref. 6:pp. 8-1 - 8-7]

5. Logistics

Logistics management objectives of joint programs are to: 1) foster economic joint performance of Integrated Logistics Support (ILS) planning, analysis and documentation; 2) satisfy essential needs of each of the participating Services; and 3) attain established readiness and supportability objectives. The lead Service should make every effort to meet the unique requirements of the participating Services. When the lead Service has designated its ILS Manager, a Joint ILS Plan (JILSP) should be prepared. The plan should be prepared in conjunction with the participating Services and should include all unique Service ILS program planning information and requirements. Each Service is usually unique in its support system, including: organizational structures, training, facilities, test equipment, and support environment. These Service differences may seriously impact the equipment design (especially maintenance characteristics), or the range of feasible support concepts, and the support resource requirements. Successful logistics management should include continual coordination between the participating Services, joint use of intermediate maintenance facilities, and proper use of tools such as the JILSP and Logistics Support Analysis (LSA). [Ref. 6:pp. 9-1 - 9-11]

6. Test and Evaluation

DOD Instruction 5000.2, "Defense Acquisition Management Policies and Procedures," Part 8, provides the general DOD policy concerning Test and

Evaluation (T&E) [Ref. 8]. In addition, each Service has its own T&E regulation which implements the DOD directive. The major tasks of T&E in a joint program are to assist in the design process and to address the areas of risk as detailed in the program charter. T&E is conducted to demonstrate the feasibility of the system, to minimize design risks, and to determine the design alternatives and trade-offs necessary to best achieve the program objectives. Developmental testing (DT&E) will be used to validate the system design and operational testing (OT&E) will be used to satisfy the operational effectiveness and suitability of the system prior to entering the next acquisition phase of the program. Although all programs have developmental and operational tests, the Services may use some different terms to specify the various points in the program cycle that the tests occur. The key feature of the review process which compares program progress with the program goals and objectives is the demonstrated performance of the system at various stages. T&E is the primary means of demonstrating performance and, based on the results, the program may be continued, redirected or canceled.

In 1978, the Joint Logistics Commanders (JLC) established a Test and Evaluation Planning Guidance *Ad Hoc* Group which was tasked to assess the joint testing environment as it existed in the late 1970s and to develop policy and guidance for greater commonality of test and evaluation effort. Some of the Group's work resulted in changes to regulations which require joint program testing to be performed in accordance with the directives of the lead Service, a Compendium of Test Terminology which was published and made available to the test community, and the establishment of a permanent joint acquisition DT&E interface group. In addition, the OT&E Commanders appointed an *Ad Hoc* Group

to resolve Multi-Service T&E and Joint T&E issues. A Multi-Service T&E is usually conducted by more than one Service for a joint Service acquisition program. The Multi-Service T&E is normally conducted in accordance with the T&E regulations and procedures of the lead Service. Joint T&E is OSD directed and funded and is structured to evaluate a system with more than one Service participating or with interacting systems from other Services. It is not normally applied to an acquisition program.

D. LESSONS LEARNED FROM PREVIOUS JOINT PROGRAMS

The Guide for the Management of Joint Service Programs presents a number of lessons learned from past joint service acquisition programs, some of which were successful and some that were not. The lessons learned were compiled from a variety of sources which include articles for the defense acquisition community and GAO reports for Congress. Since all joint programs are different, these lessons may or may not be applicable to a specific program. As previously discussed, joint Service programs in general require more planning, coordinating and effort, than do most single-Service programs. The objectives of a joint program are to increase effectiveness, decrease costs, and to exploit technology while maintaining a balance with the requirements. These lessons learned were taken from studies of joint programs from the late 1970s to the mid-1980s. Many joint programs were looked at but only those that were considered to be successful were specifically identified. The programs recognized as successful joint ventures include: the Hellfire Missile; the F-4 Aircraft; the Joint Cruise Missile; the NAVSTAR GPS; the Advanced Medium Range Air-to-Air Missile (AMRAAM); and, the Defense Satellite Communications System (DSCS).

Some of the lessons learned from these joint programs are:

1. Joint Charter. The earlier a joint charter can be established, the greater probability of program success. Early agreement on the ground rules of the program will allow the PM to proceed with minimal interference. Each participating Service should be involved in the development of the charter and the responsibilities of the various aspects of the program should be clearly defined and agreed to by all participants.

2. Leadership. The program must have strong, flexible leadership. Problems will inevitably arise between the Services and the leadership must be capable of putting aside parochial interests and making the right decision, even if it is contrary to the desires of the Service the individual is assigned to. Strong leadership is essential to remain impartial and objective and to minimize the adverse affects of external forces on the program.

3. Fairness. Equitable management and engineering procedures are critical in building and maintaining the required support of not only the Services, but also the individuals assigned to the program. There should be appropriate representation of the Services in the program management and in the engineering process. Individuals of each Service should be treated fairly and all Service unique requirements should be approached equitably.

4. Compromise. Allowances must be made for differences in procedures and approaches among the Services. An attempt must be made by each Service to minimize duplication and non-critical requirements. Cooperation among the participants can help to identify unnecessary and time consuming work for the program office and lead to shortened delivery schedules.

5. High Visibility. Joint programs are of great interest to higher authorities and require additional briefings and communication. The tendency in joint programs is for each Service to request numerous briefings to ensure that no other Service or agency is more informed. The additional briefings and communication requires much more time from the program office and is rarely conducted simultaneously for more than one Service.

6. Program Structure. The structure of the joint program office should be consistent with the strengths and needs of the Services. The primary using Service should serve as the Lead Service. Consideration should also be given to the Service with the greatest expertise in the particular systems field. The Lead Service should seek assistance from the best labs and support agencies available irrespective of Service affiliation.

7. Logistics. Logistics is typically one of the hardest areas to work out and is usually resolved by the working level specialists from the various Services rather than higher levels. Logistics problems must be resolved early in the development stage and changes should be kept to a minimum. Ideally, a single logistics system can be used for all Services.

8. Integrity. Always provide accurate data and information to the participating Services, DOD and Congress. Unquestionable integrity is always demanded in the military but it is even more important in joint programs. The oversight by Congress, DOD and the other Services requires not only truthful but also complete data and information. Individuals in a single Service program may not offer complete data or information unless it is asked for, but in a joint program, such an action may be perceived as an attempt to hide bad news. The result will undoubtedly be increased oversight and could lead to feelings of mistrust.

9. Learn from Past Programs. A final lesson learned is that with the increased emphasis placed on the joint acquisition of weapon systems by the Congress, OSD and the Joint Chiefs of Staff, the number of joint Service programs in the future will increase. A study of past joint programs can be very useful in identifying problem areas and potential solutions for future programs. However, current programs must also be studied to identify recurring problems, to determine which solutions have and have not been effective, and to provide an assessment for future potential.

An illustration from the lessons learned of one program will demonstrate how some of the issues involved with joint programs were successfully resolved. The Hellfire missile was designed from the onset to meet common performance requirements from the Army, Navy and Marine Corps. The performance requirements were agreed upon and satisfied each Service. The missiles for the various Services were virtually identical. There was only one difference between the Army version of the missile (AGM-114A) and the Navy version (AGM-114B). The Navy missile included an additional safety device to prevent accidental firing by the electromagnetic fields in the shipboard environment. Since this was the only Service unique requirement, a slight modification to the Navy missile was possible and cost effective. Additionally, the Navy OT&E was completed in a cost effective manner because it followed the Army's test and used as much of the same data as was possible. The Army had also resolved most of the problems it had encountered during its test prior to the Navy's test. The acquisition strategy the program used was also very effective. The program used competitive bids from two sources because of the larger

quantities demanded by the three Services and as a result the unit cost decreased from $43,500 in 1984 to $27,800 in 1986. [Ref. 6:p. 13-4]

III. HISTORICAL CHRONOLOGY OF THE UAV

A. REQUIREMENTS GENERATION

1. The U.S. Air Force, Navy and Marine Corps

The concept of using unmanned aerial vehicles in combat is not new. During World War II, the U.S. Air Force experimented with UAVs in an attempt to allow its limited number of trained pilots to concentrate on the most critical of missions. The UAVs were aircraft which flew a pre-programmed route and were equipped with cameras which would photograph the desired area of operations. The concept envisioned a retrieval of these aircraft and subsequent examination of the pictures would provide the required intelligence. Combat losses were heavy and, at times, out-paced the supply of newly trained pilots. The Air Force saw great potential in using UAVs for certain types of missions such as surveillance and reconnaissance. Although the program met with some positive results, the war ended before the UAV development was complete and the program was subsequently discontinued.

During the Vietnam conflict, however, enemy air defenses in some areas of North Vietnam were so lethal that the Air Force once again tried UAVs and were successful in maintaining a reconnaissance capability without a high rate of pilot loss. But, the use of UAVs was looked at as a good solution for a temporary problem and was not considered as a permanent fixture of the Air Force.

The Navy and the Marine Corps were aware of the success that the Air Force had had with the UAV and began to see potential uses of their own. The Navy envisioned an "over the horizon" capability for its ships whereby the Captain

could see beyond his direct line of sight without relying on aircraft carrier support. The UAVs could also be used in spotting for and adjusting fires for the 16 inch guns of the battleships as well as for Marine artillery. Additionally, the UAV could be used in locating vulnerable points in a beach assault or assisting in other ways with amphibious operations.

In 1985, the Navy and Marine Corps began a UAV program which would eventually field what became known as the Pioneer system.

2. The U.S. Army

The Army had been aware of the experiments with UAVs that the Air Force had conducted but did not see any great potential with the program until the Israelis successfully used remotely piloted vehicles (RPV) in the 1970s. An American engineer and model airplane buff working in Israel during the 1973 Yom Kippur War designed and constructed a large model airplane, attached a television camera, and in just six months created the mini-RPV. The RPV, unlike the UAV, could be controlled by a ground operator. He sold these RPVs to the Israeli Air Force for $40,000 each. In 1982, the Israelis used the RPVs to locate more than 18 Syrian surface-to-air missile batteries in the Bekaa Valley. Jet fighters were then dispatched and destroyed every position in less than one hour. [Ref 9]

The Army's basic concept for the UAV was to provide the ground commander with the ability to "see over the next hill." The commanders on the ground have traditionally complained that air assets have been slow to respond to their needs and that intelligence gathered by the aircraft is usually hours, or even days, old by the time it is relayed to the front lines. The Army wanted a capability for surveillance and reconnaissance that was solely dedicated to the ground

commander. An RPV similar to that used by the Israelis seemed to fit the requirement.

B. THE ARMY'S AQUILA PROGRAM

The Army established a UAV RPV program to provide its commanders with an ability to "see over the next hill" and called it the Aquila. The operational requirements set forth by the Army included the following: 1) the RPV would be forward deployed, controlled by a ground operator, and after its flight, fully recoverable; 2) since ground units move frequently, a maximum air time of three hours was thought to be sufficient; 3) the size and weight limitations would be such that four soldiers could carry the RPV; 4) because of the unpredictable terrain in the forward areas, the recovery system should be a net rather than a landing strip; and 5) its mission would be to detect, locate, and identify targets, adjust artillery fire, and designate targets for laser guided munitions.

1. The Aquila Remotely Piloted Vehicle

The Aquila RPV was a small propeller-driven, automatically and remotely controlled aircraft. It was intended primarily for target acquisition and field artillery support, and was designed to be survivable over hostile territory. The system could perform reconnaissance, detect, identify and locate targets, adjust artillery fire, laser-designate targets for destruction by laser-guided munitions, and perform battle damage assessment. The air vehicle was launched from a truck and was recoverable and re-useable. The vehicle carried a small television and eventually a Forward-Looking Infrared (FLIR) sensor. The Aquila had the following characteristics:

Weight:	265 lbs at launch
Endurance:	3 hours
Speed:	48-98 knots

2. Chronology of Events

The Mission Need Statement (MNS) for what would become known as the Army Aquila program was published in 1974. During the Concept Exploration Phase, the Army contracted with Lockheed and the first experimental flight was flown in December 1975.

In 1979, the contract for full-scale development was awarded to Lockheed, the only bidder resulting from a competitive solicitation. The following announcement appeared in the November-December 1979 issue of the U.S. Army's Field Artillery Journal:

> On 31 August 1979, the U.S. Army awarded a $101 million contract to Lockheed Missiles and Space Company for full scale engineering development of a Remotely Piloted Vehicle (RPV) system to be used for aerial target acquisition, designation, and reconnaissance missions.[1]

The Army envisioned a 43 month engineering development program and would procure 780 aircraft at an approximate unit cost of $100,000. The Army contracted with the Harris Corporation from Melbourne, Florida, for the Modular Integrated Communication and Navigation System (MICNS) which was the main data link between the aircraft and ground control units. The MICNS was Government-Furnished Equipment (GFE) which would be integrated into the RPV systems of all of the Services. Because of difficulties encountered by the other

[1] U.S. Army Field Artillery Journal, "FA Test and Development," Fort Sill, OK, Nov-Dec 1979, p. 39.

Services with the MICNS, it was eventually dropped from the plans of all of the programs except the Aquila.

Numerous technical problems ranging from controlling the aircraft while in flight to the aircraft's net retrieval system arose, as well as difficulties with the MICNS. These problems along with funding cuts in 1981, contributed to cost increases and schedule delays.

In 1982, the Army added a night mission capability to its operational requirements which further increased costs. In addition, the Army revised its employment concept to base the RPVs in rear areas of the battlefield. This change allowed the Army to reduce the total number of aircraft it would need to procure since the aircraft would now support a larger area of operations within the Corps rather than the smaller and more numerous divisions and brigades. However, the Army did not modify the specifications for size and weight, method of recovery, or maximum flight time.

In mid-1983, at the urging of the Army, Lockheed moved its Aquila Operations from Sunnyvale, California to Austin, Texas. Austin was closer to the primary test site at Fort Hood, Texas, and should have facilitated better coordination between the Army and Lockheed. The move further delayed the program.

In 1984, in light of the technical problems and continually increasing costs, the Army conducted a study of alternative RPV systems. Excluding several key factors which may have led to an alternative choice, the study found that the Army should continue with the Aquila program.

By 1985 total procurement costs had increased to $2 billion, even with a 50% reduction in the number of aircraft to be procured. Instead of procuring 780

aircraft the Army would seek to procure only 376. The development schedule increased from 43 months to 91 months.

In August 1985, the program management was transferred from the Army Aviation Systems Command (AVSCOM) in St. Louis to the more experienced Army Missile Command (MICOM) in Huntsville, Alabama. At that time, the seventh project manager in eight years was assigned and only two of 37 civilian personnel were transferred to the new program office at MICOM.

After poor results on initial contractor and Army tests, and several postponements, the Aquila completed its last operational test in March 1987. It had major problems in five of its ten performance categories.

In December 1987, although quick fixes had been applied to the problem areas, the decision was made to discontinue the Aquila program. [Ref 10]

3. Major Issues with the Aquila Program

It seems evident that the Aquila RPV was not a model acquisition program. Unit costs rose from the initial estimate of $100,000 to $1.8 million per aircraft. Delays stretched the program development schedule to twice the initial estimate. More than $50 million of Lockheed's own money was spent trying to salvage the program and several military careers were ended prematurely.

The program's failure can be attributed to a number of issues depending on one's point of view. According to a marketing director for Lockheed assigned to the Aquila project who retired shortly after the termination of the program, the Aquila fell victim to a strong Israeli/U.S. Navy lobby for an alternative to the Aquila, the Pioneer. He also attributed at least a one year delay to moving the operations office to Austin, Texas and the Army's Program Management to Huntsville, Alabama.

Additionally, he stated that the numerous technological problems were a result of underestimating the integration difficulties of the various new technologies that were being developed for the Aquila.

Conversely, the ABC News show 20/20, painted an entirely different picture. According to their investigative expose' which aired on February 13, 1986, the Aquila failure was just "another gold-plated fiasco" in the tradition of $600 toilet seats and $400 hammers. The television show attributed the four-fold cost increase and the schedule delays to Government mismanagement and contractor greed that it implied was rampant in all military procurements at the time. [Ref 9]

The actual reasons for the failure of the Aquila program probably lies somewhere between these two views. Some of the major issues which led to the program's termination were: 1) over-specification of the system requirements and the changing of operational requirements; 2) inappropriate Government/contractor relationship and bias; and 3) program mismanagement.

The first issue of over-specification and changing of the operational requirements may have initially been the result of the Army's desire to keep the RPV unique from the UAV efforts the Navy was involved with at the time. The size of the RPV was restricted to be a four-man portable airframe with a 13 foot wingspan. It was to be employed in forward areas away from landing strips, which would require a net recovery system. The requirement called for a minimum of three hours of flight time. It had to include a laser designator in its payload, and would integrate the MICNS data link system. Initially, the only requirement for the television system was that it should be useable in daylight hours and periods of good visibility. Later, this specification was changed because of a new 24 hour operational requirement placed on the program which necessitated an infrared system. The infrared system

made the Aquila more "saleable" to its critics, but, unfortunately, this added to the program's delay as the new technology was incorporated into the RPV system and also raised the unit cost by $900,000. The size constraints also presented problems throughout the program. Controlling the aircraft was very difficult once all of the required payloads were added. A three hour flight time gave more than adequate on-station time when the RPV was to be forward deployed. But, as the operational requirements changed to a rearward deployed concept and the flight time to the area of operations increased; on-station time was reduced by one third to only 1 1/2 to 2 hours. The net recovery concept was also a requirement because the system was to be forward deployed, however, when the operational requirements changed, the specifications did not. The only advantage gained in changing to a rearward deployed system was in the reduced number of aircraft required to support the larger but less numerous corps. Had the specifications been changed, a number of alternative RPVs would have been better suited to perform the required missions. Several of the alternatives (which were larger in size) could carry the required payloads, were easier to control by the ground operators, and could be recovered either by net or by landing strip. [Ref. 11]

The requirement for integrating a laser-designator was a key requirement that differed from UAV programs undertaken by other Services. The laser-designator would allow the RPV to designate targets for the Army artillery's Copperhead shell which was a laser guided, armor penetrating round. The weight and integration problems of the laser-designator contributed to the program's delays. Because of the laser capabilities employed by the Apache and Scout helicopters, this requirement could conceivably have been eliminated or postponed for the Aquila since the ability to kill enemy armored vehicles was not a critical requirement. The MICNS

system, which was GFE, contributed to the delays as well. The first MICNS was not integrated with an RPV until mid-1984.

Whether or not the changes in operational requirements were an attempt by the Army to keep the program competitive, they indicate that the initial specifications were not necessarily inflexible requirements. Certainly some of the over-specifications and the changing requirements contributed to the cost overruns and delays. The deletion of some of the specifications would have resulted in a system which would have closely approximated that which the Navy was developing at the time.

The next issue is that of Government/contractor relationship and bias. Several GAO investigations indicate that, although the contract may have initially been competitive, the Army clearly preferred Lockheed as its contractor. In 1984, when the Army conducted a study of alternative RPVs, it excluded three key factors: Life Cycle Costs; a revised RPV employment concept; and future mission payloads. According to a GAO report to Congress in January 1986, had these three factors not been excluded, an alternative would most likely have been selected for continuation of the program [Ref 10].

The relief of key program office personnel during the difficult periods in the program may have indicated to their replacements that their success would be measured by the success of the program. Each major set-back with the Aquila seemed to result in the appointment of a new program manager. The program office, fearful for its own security, began to make every effort to help Lockheed in its performance of the contract. In some cases, the degree of help from the military was excessive. The GAO reported in October 1987, after the last OT&E, that the results were misrepresented on several issues in favor of the contractor based on a

Lockheed engineer's very questionable explanations or quick fixes. The contractor's presence and participation in the OT&E were in violation of the applicable regulations and instructions for the conduct of the test. [Ref 11] Even the reduction in the number of aircraft to be procured was perceived as an attempt by the Army to control costs in order to bring less attention to the problems with the program and to give the impression that the contractor was successfully completing its mission.

The final issue which led to the termination of the Aquila program was one of mismanagement on the part of the Army as well as the contractor. The reasons for poor management on the part of the Army are debatable but the fact that there were seven PMs in eight years is an indication that effective management was lacking, if not impossible to achieve. The transfer of the program to MICOM was based more on the superior program management reputation that MICOM had within the Army acquisition community than on system compatibility. Even though the program management was more effective at MICOM, the transfer itself contributed to further delays.

The contractor also lacked good, strong management with the Aquila. During the Concept Exploration Phase of the program, the aircraft carried $50,000 cameras on the early flight tests. There were numerous crashes during these early flights and each time the camera was a total loss. Although the engineers working on the program advised against flying the aircraft with the cameras on board, the management thought that flights with the actual equipment would be of greater benefit than trying to reduce expenses. This lax attitude towards conserving funds prevailed as the contractor continually advanced to more difficult stages of the program without resolving all of the technical problems encountered in previous stages.

4. The End of the Aquila

In December 1987, in light of budget realities, questions of affordability, and guidance to kill rather than stretch out programs, the decision was made to terminate the Aquila program. Although the Aquila had successfully demonstrated fixes in the Force Development, Test, and Experimental (FDTE) tests and was considered producible, it was not affordable. The Army position then supported the development and fielding of a cost effective mix of UAVs. As a result of this position, the Army became actively engaged with the other Services to determine a strategy and management concept to achieve joint requirements and maximize commonality in UAV programs. [Ref 12]

C. THE PIONEER PROGRAM

During the same period that the Army was developing the Aquila, the Navy and Marine Corps were also in search of a UAV. The Pioneer was designed to be employed on land, from battleships or from amphibious ships. The Pioneer has the following characteristics:

Weight:	430 lbs at launch
Endurance:	5 hours
Speed:	60-95 knots

The Pioneer is significantly heavier than the Aquila with a weight of 430 pounds versus 265 pounds and also has a longer wingspan at 16 feet 10 inches versus 13 feet. However, it has a longer endurance and faster speed. The primary mission that the Navy and Marine Corps envisioned for a UAV was to provide continuous aerial reconnaissance around an Amphibious Ready Group (ARG) while enroute to an objective and while operating in the objective area. Other possible

uses for a UAV included providing Marine Corps ground commanders an organic ability to "see what's on the other side of the hill," especially during amphibious operations. They could also be used to provide a means of locating targets and adjusting fires for the 16 inch guns of the battleships. [Ref. 15:pp. 40-42]

In 1985, the Navy initiated the Pioneer program and contracted with AAI Corporation, which was teamed with Mazlat, an Israeli company. The Pioneer is a small propeller-driven, automatically and remotely controlled aircraft, similar to the Aquila. The Pioneer uses a runway takeoff or a pneumatic catapult and is recovered with a net or on a landing strip. The Pioneer is an improved version of Israel's combat tested Scout RPV but experienced some major difficulties in its early developmental stages. The first Pioneer system was delivered to the Navy in May 1986. During the first six months of operation, several vehicles crashed: two due to engine failure after launch, two were lost at sea for unknown reasons, and two crashed during recovery. After several improvements were made to the system it satisfactorily demonstrated its capabilities aboard the USS Iowa and with Marine Corps companies.

D. UAVs IN DESERT STORM

During Operation Desert Storm, the Pioneer UAVs flew 533 sorties for a total of 1,688 hours. At least one Pioneer was airborne at all times during the war. The missions the Pioneer performed included targeting, artillery and naval gunfire adjustment, reconnaissance and real-time battle damage assessment. The Pioneer was also involved in the first ever "surrender" of enemy soldiers to an unmanned aircraft. A Pioneer from the USS Wisconsin was intentionally flown low over the Faylaka Island to let the Iraqis know that they were being targeted. Since the

previous sightings of the small aircraft were followed by devastating attacks by the 16 inch guns of the battleships, hundreds of Iraqi soldiers began waving white flags at the RPV and were eventually captured.

The Marines used the Pioneer to direct air strikes and to provide near-real-time reconnaissance for SEAL teams and Force Reconnaissance prior to and during special operations.

The Army also used the Pioneers in Kuwait and Iraq during Operation Desert Storm. During the ground offensive, battlefield commanders had success in using the Pioneer to locate enemy positions, strengths, movements, and tactical disposition with near-real-time support. Brigadier General Creighton Abrams, the Commander of the 7th Corps Artillery, stated that "thanks to the PIONEER, the Army was able to take out every piece of artillery that could reach the breach, and as a result not a single round of artillery fell on Army units coming through." [2]

The DOD fielding objective for the Pioneer has been completed. A total of nine Pioneer systems have been fielded with five in the Navy, three in the Marine Corps and one in the Army.

In addition to the Pioneer, the Pointer and Exdrone UAV systems were also deployed in Southwest Asia. While all of the systems performed well overall, there were some difficulties with each of the systems in one or more of the following areas: Communications, Launch/Recovery operations, position location reporting, target resolution, transportability, mission flexibility and maneuverability. The UAVs in Desert Storm validated the need and capabilities of unmanned aircraft but

[2] Garrison, Major L. C., "Pioneer in the Gulf War, 3rd Release," DON Report on The U.S. Navy in Desert Shield Desert Storm, Office of CNO, Washington, D.C., 15 May 1992

because of the short comings of each system, a new program would be needed to meet the future needs of the Services.

There were no Aquila RPVs employed during Desert Storm. Despite the expenditure of nearly $1 billion on the Aquila prior to its cancellation, the Army had no working models or prototypes in its inventory for use during the conflict.

E. FORMULATION OF THE JOINT UAV PROGRAM

In 1986, the House Appropriations Committee was briefed that there were no fewer than 12 separate RPV/UAV programs within the DOD at the time [Ref 13]. The programs included the Aquila and Pioneer as well as the Pointer, the Skydancer, the Amber, the AROD, the CL-227, the Exdrone, the Mercury Green, the Sprite and the UARS. Congress was concerned with the failures of the Aquila and other UAV programs and pointed to several problem areas including: 1) an apparent duplication of effort; 2) extremely high program costs; 3) limited applications; and, 4) an unfocused DOD strategy. As a result, Congress was compelled to act.

In December 1987, development and procurement funding for UAVs was consolidated at the Office of the Secretary of Defense, as mandated by the Fiscal Year 1988 Appropriations Act, Public Law 100-202. The Act required that all Service efforts be re-evaluated and a master plan be developed to ensure a coordinated acquisition strategy for Service UAV needs. Both the Senate and the House refused to provide additional funds for the Aquila or any other individual Service UAV program until a joint program was established. The Senate language specifically addressed the Remotely Piloted Vehicles programs within all of the Services by stating:

> Separate program elements for these efforts within each military service have been eliminated, and the funds have been transferred to the Office of the Secretary of Defense, which should establish funding and program priorities, mandate requirements for single programs to meet the needs of more than one service, and eliminate duplicative programs. To encourage the elimination of such duplication, the Committee recommends that the Joint RPV Program receive $52,610,000 in fiscal 1988, a reduction of $52,610,000 from the budget request.[3]

Prior to this time, the Services had been proceeding independently with the acquisition of different systems even though the basic purpose and functional requirements of the UAVs were very similar. As Congress had noted, there was no unity of management, commonality of hardware, or a clear, well-defined mission specified for the integration of the equipment within DOD. The Services recognized the same deficiencies as Congress had, but were reluctant to act towards a unified effort until the Congress directed that it be done. DOD was therefore directed to unify the management of all non-lethal UAV system acquisitions and the funding for each individual UAV program would not be released until the master plan for a joint acquisition program had been submitted to and approved by Congress.

The success of the UAVs in Southwest Asia indicated that there did indeed exist a valid need for the capabilities provided by UAVs. There was enthusiastic support at the highest levels of each Service for continued development of a UAV system. The successful employment of a single system by more than one Service also indicated that a joint program was not only a viable option but probably should have existed all along. Had there been a joint program from the beginning, the Army would most likely have had more than one system in use during Desert Storm.

The realties of a decreasing budget also demanded that the development and procurement of UAVs in the future be more cost efficient. Since R&D in UAVs had

[3] Congressional Mark and Language Summary for FY89, 3 August 1988.

already existed for many years and there were several contractors at an advanced stage of development, the Congress felt that while a reorganization of the acquisition process was needed, the program should not need to start over at step one. The goals of the Congress were to establish a joint service UAV management and technical structure, to reach agreement on system requirements, to acquire UAVs on a joint basis, and to quickly procure a short range system using existing off-the-shelf technology. Congress had no desire to unnecessarily delay the delivery of operational systems to the users but insisted that the program be managed more efficiently.

F. SUMMARY

Although the operational requirements for the Aquila and Pioneer systems were very similar, there is no indication that a joint Service program between the Army and the Navy was ever seriously considered by either Service. Instead, much time, effort, and money was spent by each Service to develop separate systems. Many of the same issues which plagued the Joint TFX Program also contributed to the reluctance of each Service to enter into a joint venture for UAVs. However, the level of duplication found in the 12 different programs combined with the adverse publicity surrounding the very costly overruns, compelled the Congress to intervene. If any of the UAV programs were to proceed, it would only be through the efforts of a joint program.

IV. THE JOINT UNMANNED AERIAL VEHICLES PROGRAM

A. INTRODUCTION

The joint unmanned aerial vehicles program strives to provide an inexpensive and effective means of gathering information for both the battlefield and naval commander without risking the capture or loss of friendly forces. In today's era of declining defense budgets, the UAV is perceived to be a cost effective alternative for supplementing the more expensive manned aircraft systems. The primary mission of the UAVs is to provide reconnaissance, surveillance, and target acquisition (RSTA). Additional missions include: surveillance for combat search and rescue; adjustment of indirect fire weapons; rear area security support; battle damage assessment; and, radio and data relay. UAVs can also provide capabilities in electronic warfare (EW), electronic support measures (ESM), command and control and special operations. Allocating these types of missions to UAVs increases the survivability of manned aircraft and allows pilots to concentrate on the more demanding missions that require the flexibility of manned systems [Ref 17].

As previously stated, the UAV JPO is the result of Congressional direction to consolidate all of the nonlethal UAV programs within the DOD. DOD responded by forming a UAV Joint Project Office and designating the Navy as the Executive or Lead Service. A UAV Executive Committee (EXCOM) was established and charged with oversight responsibility. The members of the EXCOM were the Vice Chairman of the Joint Chiefs of Staff (JCS), the Director of Defense Research and Engineering (DDR&E), the Assistant Secretary of Defense for Command, Control,

Communications, and Intelligence (ASD[C^3I], and the Service Acquisition Executives (SAE) of the Army, Navy, and Air Force. When the JPO submitted a UAV Master Plan to Congress, funding authority was reinstated. The program can be classified as a Joint Program Category S-6, i.e. a Fully Integrated Joint Program Office as defined in Table I, Chapter II.

The UAV JPO's mission is "to expeditiously field quality UAV systems which provide a significant tactical advantage to operational commanders." In addition the JPO provides advice and guidance to other Federal agencies interested in employing UAVs, and is guided by the following principles as outlined in the JPO Master Plan: [Ref. 15:pp.1-2]

a. Continuously improve the process to develop, procure, and support UAVs.

b. Develop an affordable family of UAV systems that are interoperable.

c. Proactively foster the use of non-developmental items (NDI) and commonality in order to achieve lowest operational cost.

d. Continuously address and support the expectations of all UAV customers; consider the users as partners with the UAV JPO.

B. PROGRAM ORGANIZATION AND MANAGEMENT

1. Establishment of the UAV JPO

In response to the Congressional direction, the USD(A) created a unique joint Service organization for UAV management. The EXCOM was charged with overall responsibility at the OSD level and the joint program office structure was similar to Structure D from Chapter II and is depicted in Figure 2.

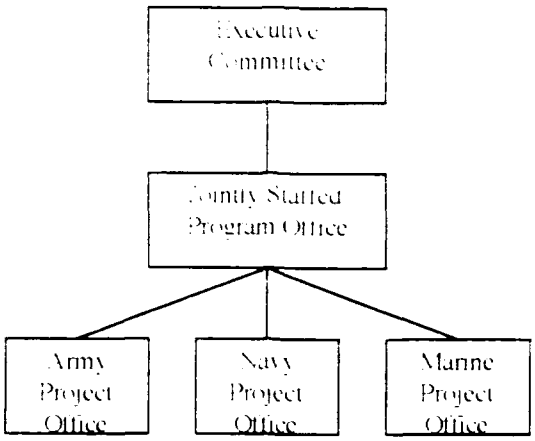


Figure 2 UAV Program Office Structure

In 1991, the EXCOM was disestablished and the UAV JPO was brought under standard Defense Acquisition Board (DAB) milestone procedures and management. Most of the members of the EXCOM were also members of the DAB and felt that the program was progressing well enough that it could follow the more conventional acquisition process. The streamlined procedures allowed the program to bypass many DAB requirements but also required more input and oversight by the EXCOM. The UAV was classified as a major acquisition program and was designated Acquisition Category (ACAT) ID whereby the milestone decision authority is the USD(A). The current management organization for the UAV is as depicted in Figure 3.

The DAB is chaired by the USD(A) and the vice chairman is the Vice Chairman of the JCS. The other members include the Army SAE, the Navy SAE, and the Air Force SAE; the DDR&E; the Assistant Secretary of Defense for Program Analysis and Evaluation (ASD[PA&E]); the Comptroller of the Department of Defense; and the Director of Operational Test and Evaluation [Ref.

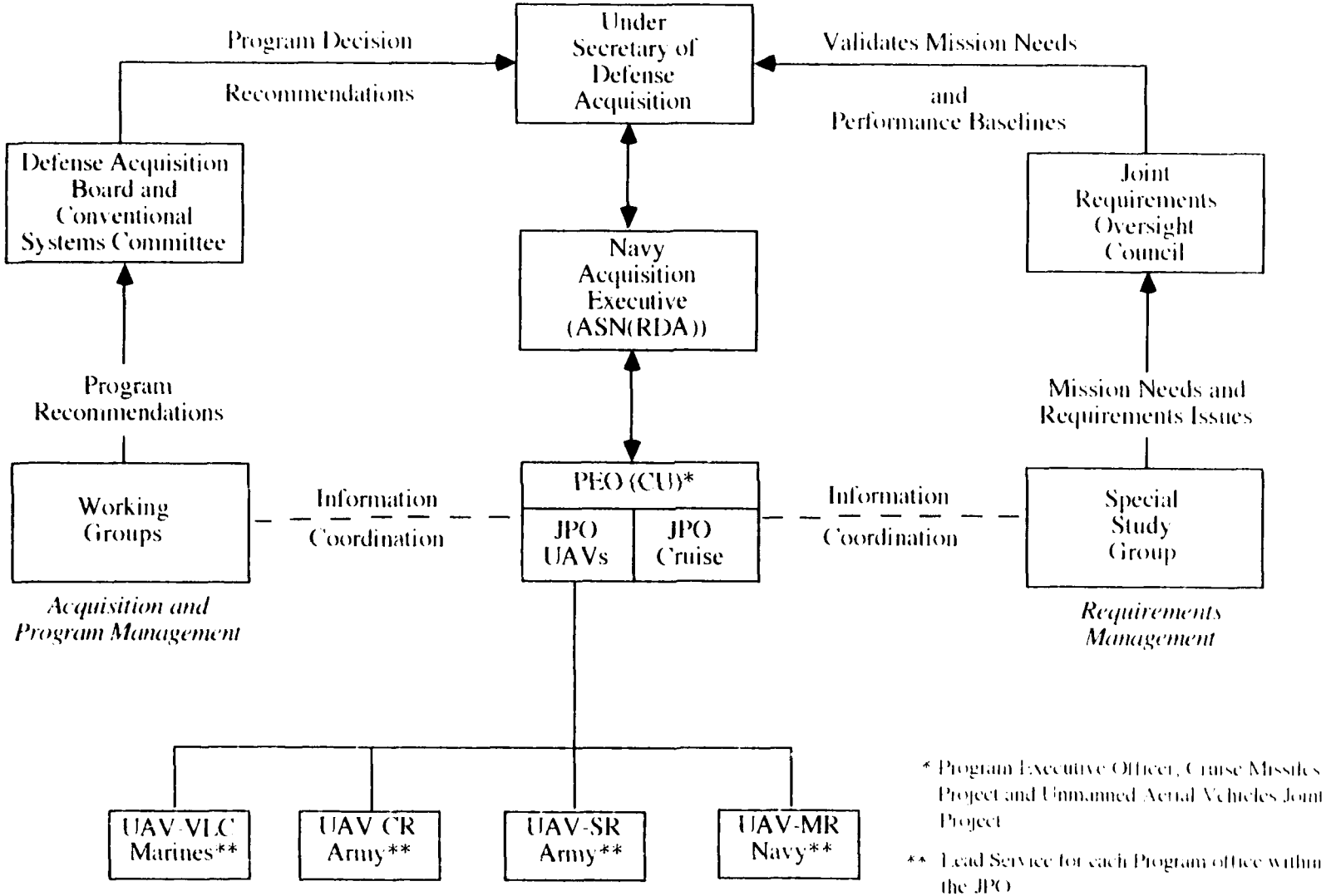


Figure 3 UAV Management Organization

2:p. 2-4]. The DAB, along with the Conventional Systems Committee (CSC), is responsible for oversight, providing program direction and approving milestones for the UAV JPO.

2. Management of the UAV JPO

The Navy, as the Executive Service, is responsible for designing, developing, procuring and transitioning UAV systems to the Services. The UAV Special Study Group (SSG) consolidates and reconciles requirements before presenting them to the JROC for approval. The Working Group includes representatives of the DAB/CSC, plus the National Security Agency (NSA), Defense Advanced Research Projects Agency (DARPA), UAV JPO and other designated elements of OSD and Service staffs. The Working Group conducts analyses and provide recommendations to the DAB and CSC. The UAV JPO confers with the Working Group and the SSG to resolve requirements related issues.

The UAV JPO receives program guidance through the chain of command depicted in Figure 3. The Program Executive Officer (PEO) for the UAV JPO is also the PEO for the Joint Cruise Missiles Project. He currently is responsible for 12 different programs and has a Deputy PEO (a civilian) who also serves as the Director of UAVs. [Ref 18]

3. The Family of UAVs

The first UAV DAB review was held on 10 December 1991 and the approved final plan established a "family" of UAV systems. Upon review of the various operational requirements, it became clear that more than one UAV would

be required to meet all of the Services' needs. The family of UAVs includes a long range Endurance system; a fast Mid-Range system; a simpler Short Range system; and an inexpensive Close Range System for immediate unit level support. Table II provides a summary of the Mission Need Statements for the four categories of UAVs. The Acquisition Decision Memorandum (ADM) resulting from the DAB, dated 3 January 1992, also changed the classification of the Close Range (CR), Short Range (SR), and Medium Range (MR) UAVs from individual ACAT II to ACAT I programs [Ref. 19]. Each of the systems is managed by a separate program office which reports to the UAV JPO. The CR and SR programs are managed by the Army and are located in Huntsville, Alabama. The MR program is managed by the Navy and is located in Washington, D.C. Additionally, there is a Very Low Cost (VLC) UAV program managed by the Marines which is located in Quantico, Virginia.

The Close Range (CR) system is primarily designed for use by Army divisions and brigades/battalions and USMC battalions/companies for a capability within their local area of interest (approximately 30 kilometers [km]). These systems must be easy to launch, operate and recover and require minimum manpower, training and logistics. They must also be relatively inexpensive.

The Short Range (SR) systems support Army divisions and corps and USMC Air-Ground Task Forces (MAGTF). These systems can operate out to a range of 150 km beyond the forward line of own troops (FLOT) and are more sophisticated, can carry a wider variety of payloads, and can perform different kinds of missions than CR systems.

The Medium Range (MR) systems provide pre- and post-strike reconnaissance of heavily defended targets and augment manned reconnaissance

TABLE II. JOINT PROGRAM MISSION NEEDS

	CLOSE	SHORT	MEDIUM	ENDURANCE
OPERATIONAL NEEDS	RS, TA, TS, EW, MET, NBC	RS, TA, TS, MET, NBC, C2, EW	PRE AND POST STRIKE RECONNAISSANCE, TA	RS, TA, C2, MET, NBC, SIGINT, EW, SPECIAL OPS
LAUNCH AND RECOVERY	LAND/SHIPBOARD	LAND/SHIPBOARD	AIR LAND	NOT SPECIFIED
RADIUS OF ACTION	NONE STATED	150 KM BEYOND FORWARD LINE OF OWN TROOPS (FLOT)	650 KM	CLASSIFIED
SPEED	NOT SPECIFIED	LOITER 100 KNOTS, DASH 300 KNOTS	550 KNOTS, 25,000 FT, MACH 0.8, 20,000 FT	NOT SPECIFIED
ENDURANCE	24 HRS CONTINUOUS COVERAGE	8 TO 12 HRS	2 HRS	24 HRS ON STATION
INFORMATION TIMELINESS	NEAR REAL TIME	NEAR REAL TIME	NEAR REAL TIME, RECORDED	NEAR REAL TIME
SENSOR TYPE	DAY, NIGHT, IMAGING, EW, NBC	DAY, NIGHT, IMAGING, DATA RELAY, COMM RELAY, RADAR, SIGINT, MTI, MASINT, LTD, EW	DAY, NIGHT, IMAGING, SIGINT, MTI, EW	SIGINT, MTI, COMM RELAY, DATA RELAY, NBC, IMAGING, MASINT, EW
AIR VEHICLE CONTROL	NONE STATED	PRE PROGRAMMED, REMOTE	PRE PROGRAMMED	PRE PROGRAMMED, REMOTE
GROUND STATION	VEHICLE & SHIP	VEHICLE & SHIP	JSIPS/PROCESSING	VEHICLE & SHIP
DATA LINK	WORLDWIDE, PLAT, TIMELY, SAGE, ANTIJAM CAPABILITY	WORLDWIDE, PLAT, TIMELY, SAGE, ANTIJAM CAPABILITY	JSIPS INTEROPERABLE, WORLDWIDE, PLAT, TIMELY, SAGE, ANTIJAM CAPABILITY	WORLDWIDE, PLAT, TIMELY, SAGE, ANTIJAM CAPABILITY
CREW SIZE	MINIMUM	MINIMUM	MINIMUM	MINIMUM
SERVICE NEED REQUIREMENT	USA, USN, USMC	USA, USN, USMC	USN, USAF, USA	USA, USN, USAF

LEGEND

C2 - Command and Control
MET - Meteorology
TS - Target Spotting
SIGINT - Signals Intelligence
EW - Electronic Warfare
TA - Target Acquisition
LTD - Target Designator
RS - Reconnaissance and Surveillance
JSIPS - Joint Service Imagery Processing System
MASINT - Measurement and Signatures Intelligence
NBC - Nuclear, Biological and Chemical Recon

Source: Master Plan, p. 80

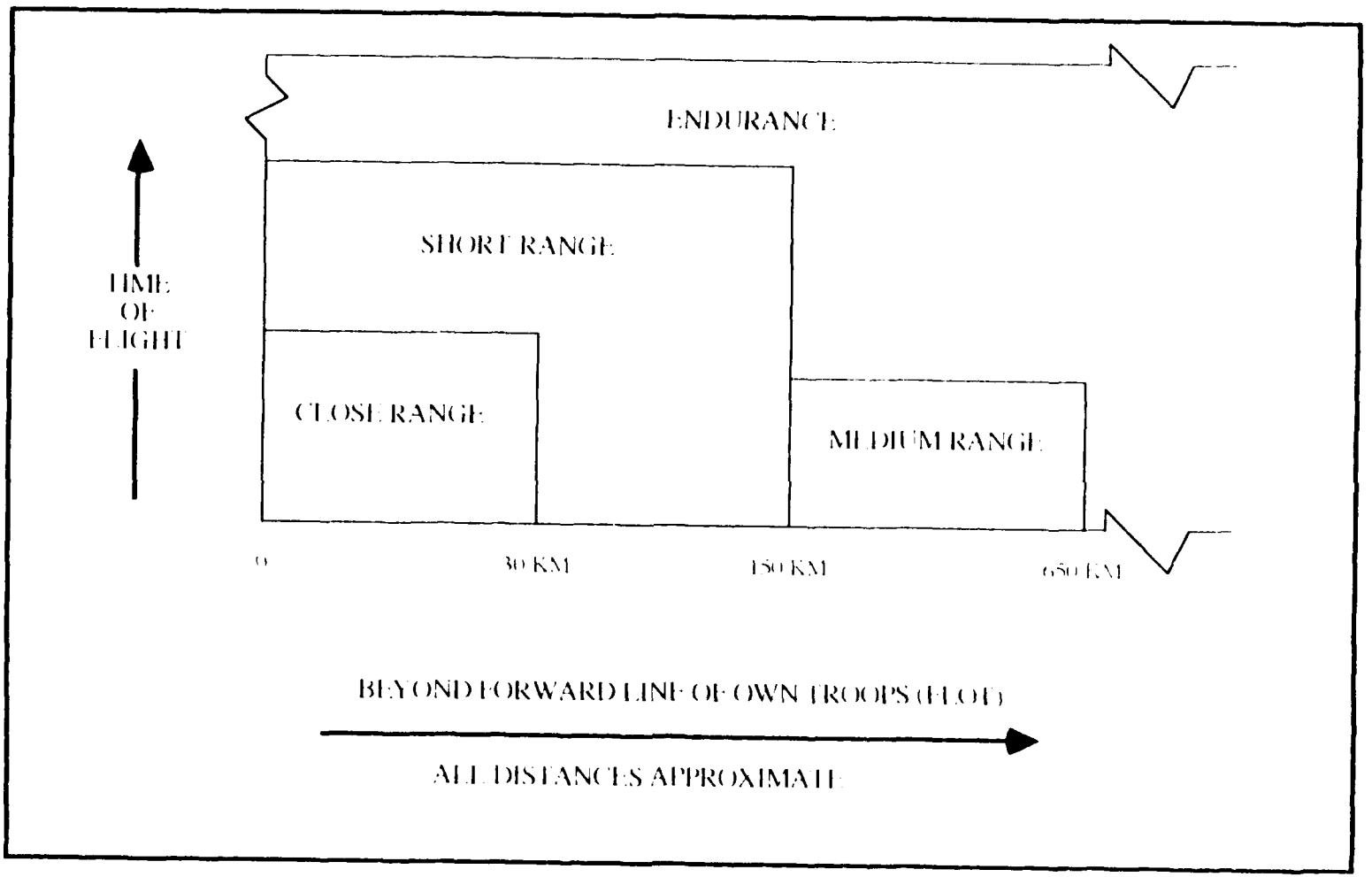
aircraft by providing high quality, near-real-time imagery. These vehicles are designed to fly at high subsonic speeds but have limited on-station time over the target areas.

Endurance UAVs are characterized by times of flight measured in days and very great ranges and altitudes of flight. They can perform a wide variety of missions and can carry many different types of payloads. The Mission Need Statements of the four categories have been validated by the Chairman of the JROC. The required capabilities of the UAV categories is graphically depicted in Figure 4.

In addition to the family of UAVs, the JPO also assumed responsibility for all other non-lethal UAV systems that had previously been in some form of development. The UAV JPO is responsible for the management of logistics, training, and test support for the Pioneer systems which are currently fielded and are expected to remain operational until replaced by the SR system in FY98. Several other UAV programs which are currently in various stages of development but are not specifically funded are grouped into a concept demonstration category and include the Maritime Vertical Takeoff and Landing UAV, the Pointer, the Exdrone, and the Tilt Wing/Rotor (VTOL).

4. Acquisition Strategy

The UAV acquisition strategy is based on rapidly fielding common and interoperable systems to meet operational requirements. The strategy includes: 1) operational requirements agreed to by the Services and Unified and Specified Commands; 2) procuring off-the-shelf technologies and commercially available components; 3) enhancing future capabilities through block upgrades; and, 4)



(Source: Master Plan p. 9)

Figure 4 Categories of Capabilities

ensuring interoperability with the command, control, communications and intelligence (C^3I) systems of all Services and Commands.

An estimate of the desired procurement for each UAV system according to the current Master Plan is provided in Table III.

TABLE III. PLANNED PROCUREMENT

	CR	SR	VTOL**	MR
Air Vehicles	1260	384	140	550
Payloads	1878	768	208	542
Systems*	176	48	--	--

*A system may include air vehicle(s), more than one kind of payload, mission planning and control station (MPCS) equipment, launch and recovery equipment and ground support equipment.

**Not presently resourced.

(Source: UAV Master Plan:p. 10)

5. Interoperability and Commonality (I&C)

The UAV JPO recognizes the importance of interoperability and commonality in the acquisition of effective UAV systems. This is a key benefit derived from the joint status of the program. Since the UAV systems have many common functions and can share as much common equipment and associated software as possible, cost benefits should result. The systems must also be capable of operating with the various Service and Unified and Specified Command C^3I operations as well as with other UAVs in order to be effective on the battlefield.

The UAV JPO has established a common UAV design architecture based on the SR program which is developing an interoperable data link subsystem for the entire UAV family to ensure communications capability between the systems. An objective of the JPO is to minimize the number of new data links required in order to integrate the UAVs into the Services' force structures. All UAV ground stations should be able to receive and use data from and be able to control the different types of air vehicles, regardless of the system mix.

The basic strategy of the UAV JPO is to consider the use of existing UAV system components and software modules when developing options for new UAV capabilities. Developing subsystems in modules will allow for easy interchanging of components from one system to another and will also facilitate technology upgrades.

Because of the most urgent Services' needs, the SR system was selected as the basis for interoperability, and accelerated acquisition was directed. The SR system thus became the centerpiece of the UAV acquisition strategy. Since the SR program is at a more advanced stage than any of the other UAV systems and the SR Project Office is managed by a Service other than the lead Service, it provides the best opportunity for an analysis of a joint service program. The other programs within the UAV will not be specifically analyzed but will be referred to when their actions either impact on or are impacted by the SR program.

C. THE SHORT RANGE UAV SYSTEM

1. Background of the UAV-SR

At the same time that development and procurement for UAVs was consolidated at the OSD level in December 1987, funding for the Army's Aquila RPV program was terminated. When the Joint Service UAV Master Plan was submitted to Congress in June, 1988, the framework which had managed the latter stages of the Aquila program became the nucleus of the new UAV-SR Project Office. The UAV-SR system was given to the Army to manage since the Army and the Marine Corps were envisioned as the primary users. The SR UAV is to provide near-real-time RSTA to Army echelons above corps, divisions and USMC expeditionary brigades out to 150 km beyond the FLOT. The following Mission Need Statement for the SR System was approved by General Herres, the Chairman of the JROC, on 16 December 1988:

> A day and night imagery collection and near-real-time reporting capability that can survey enemy elements and transmit to ground-based or airborne battle management systems is essential to field commanders. A cued, penetrating unmanned aerial vehicle system will meet the need without the vulnerability and risk factor associated with the use of manned aircraft. Specifically, the UAV-SR will provide a capability to obtain information important to battlefield management, including target identification. [4]

An Army Colonel was assigned as the PM immediately after the Program Office was established. The EXCOM approved an acceleration of the program since the program management organization was not entirely new and

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[4] Memorandum For Commander Naval Air Systems Command, "Program Endorsement Memorandum on NAVAIR Acquisition Plan AIR 89-2 For The Joint Short Range Unmanned Aerial Vehicle System (UAV-SR)," 28 February 1989.

because the Services had apparently reached a consensus on the program requirements.

The UAV Charter directed that the SR system serve as the developmental baseline for the family of UAVs and that the acquisition strategy should ensure interoperability and maximize commonality. The program focuses on the fielding of a prototype which would serve as the baseline and upon which block upgrades could be made to meet all operational requirements. The modular approach in designing the architecture allows for upgrades and provides a flexible baseline for the other systems as well.

2. Budget and Funding

The FY89 Appropriation Act included $41M(million) RDT&E and $51M Procurement funds for all UAV programs for that year. Of the funds, $35.7M Procurement and $12.5M RDT&E were for the Short Range UAV. Budgeting for the UAV JPO is sponsored by DOD in a unique arrangement. The OSD Program Element (PE) 0305141D contains the RDT&E and Procurement funds for UAVs. These funds are used to support the RDT&E for the systems, subsystems, components and interoperability/commonality efforts in addition to the Procurement of all UAV systems. DOD is responsible for the program funding but the actual execution of the funding is the responsibility of the UAV JPO. The UAV JPO does have limited flexibility to shift funds within the JPO. In most joint programs, funding is either budgeted through the lead Service for the entire program or through each participating Service which pays its proportional share.

Since the operational requirements for the UAV-SR were similar to those of the Aquila and Pioneer programs and a strong developmental base

already existed to meet the SR requirements, the program could compete for non-developmental items (NDI) and therefore require less RDT&E funding than the other systems. The total estimated budget for the UAV-SR program according to the Acquisition Plan No. AIR 89-2, dated 12 December 1988 for the years through FY 93 is shown below in Table IV.

TABLE IV. UAV-SR PLANNED FUNDING FY89-FY93

	FY89	FY90	FY91	FY92	FY93
Procurement	35.7	18.8	17.0	120.0	110.0
RDT&E	12.5	15.0	15.0	15.0	20.0
TOTAL	48.2	33.8	32.0	135.0	130.0
Systems	4	--	--	6	9
(In millions of dollars)					

(Source: Acquisition Plan No. AIR 89-2;p. 3)

The budget realties, especially in the acquisition climate of today, almost certainly guarantees that the budget a program plans for will not remain constant throughout the life of the program. Most PMs reluctantly accept the fact that their budget will most likely be reduced. However, in the case of the UAV, the program actually experienced a growth in its budget. The actual funded amounts for FY92 and FY93 increased from the amounts planned for in the Acquisition Plan. For FY92 the RDT&E funds increased from $15M to $15.2M

and the Procurement funds rose from $120M to $132.7M. In FY93 the RDT&E funds went from a planned $20M to $31.4M and Procurement funds increased from $130M to $144M. [Ref. 20:p. 3]

3. UAV-SR Program Management Organization

The UAV-SR Project Office is located at Redstone Arsenal in Huntsville, Alabama. The program is a tenant organization within the Missile Command (MICOM). The program competes with the other Army acquisition programs at Redstone (most of which are assigned to PEO Tactical Missiles) for matrix personnel and other service support from MICOM. The UAV JPO is located in Washington, D.C. The current staffing of the project office is as outlined below.

TABLE V. UAV-SR PROJECT OFFICE MANNING

	Civilian		Military	
	Authorized	Assigned	Authorized	Assigned
Core	33	33	5	5
Matrix	48	45	3	3
Total	**81**	**78**	**8**	**8**

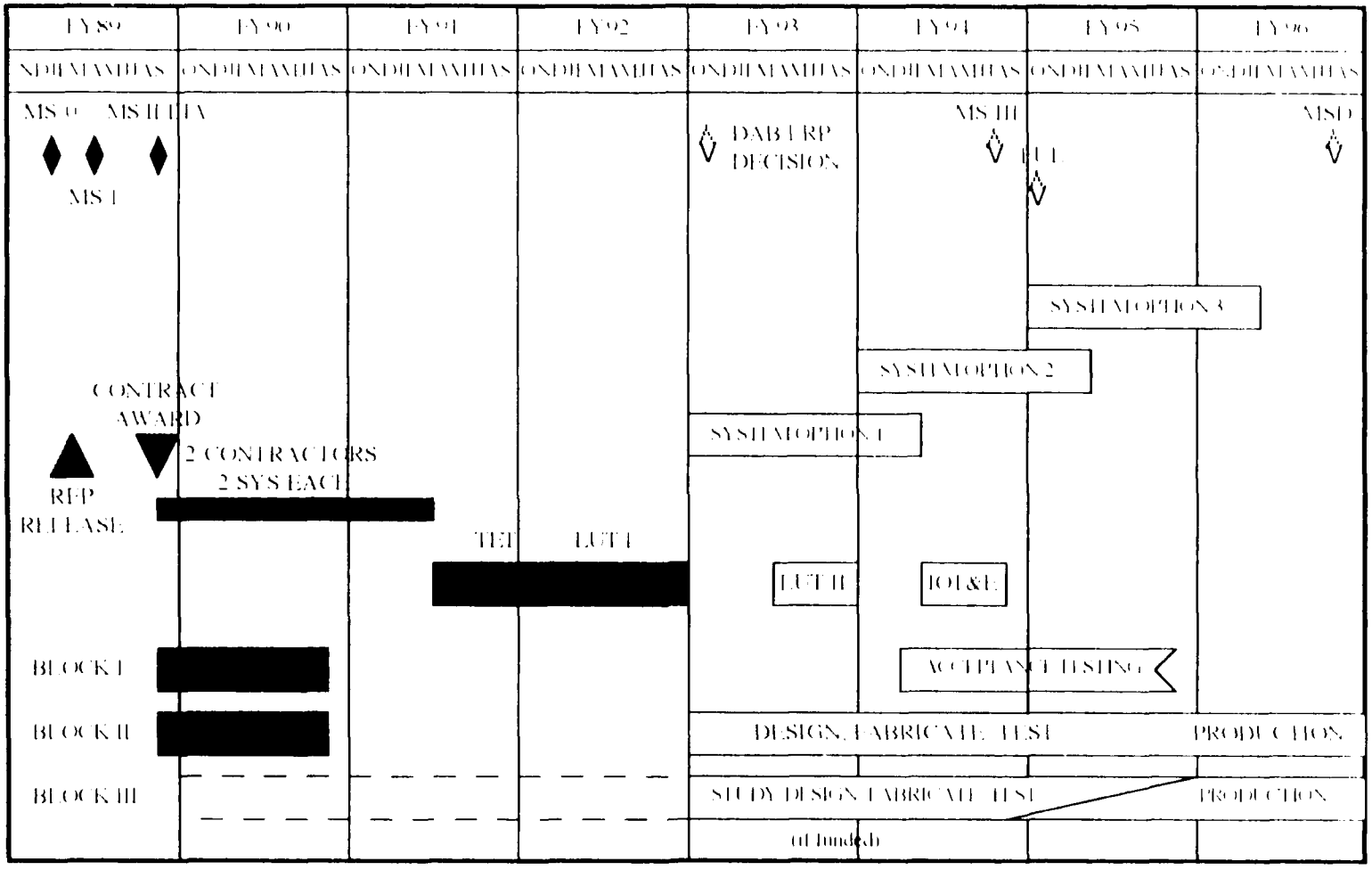
Source: UAV Program Office Briefing Slides, 9 Apr 92

The entire UAV-SR Project Office is currently manned by Army active duty and civilian personnel. The Marine Corps had one representative assigned to the project office until he was transferred to the recently established UAV-CR project office which is also located at MICOM.

4. UAV-SR Program Progress

A full and open competition began the acquisition of the UAV-SR in FY89. A draft request for proposal (RFP) was provided to industry in December 1988 and was followed by the final RFP in March 1989. The proposals were based on a fixed-price-incentive contract for the production of two integrated SR systems for testing and price options for three production lots in FY92, FY93, and FY94. Based on the responses from industry, contracts were awarded on 15 September 1989, to McDonnell Douglas Missile Systems Company of St. Louis, Missouri and Israeli Aircraft Industries Ltd. of Tel Aviv, Israel. The two contractors were allotted 18 months to prepare delivery of complete SR systems before a Technical Evaluation Test (TET) and Limited User Test (LUT) would be conducted to select the eventual contract winner. The competitive demonstrations were scheduled to begin in March 1991. [Ref 20] The SR baseline schedule is shown in Figure 5.

Both contractors experienced delays in equipment deliveries and in achieving readiness for the tests. The program schedule was delayed for six months. The technical testing began in July 1991 and was completed in April 1992. The LUT was completed in July 1992. The outcome of the TET and LUT resulted in the selection of Israeli Aircraft as the winning contractor. The evaluation criteria used were cost, technical characteristics, logistics, and



(Source: UAV-SR Briefing Slides, 11 Feb 92)

Figure 5 UAV-SR Program Schedule

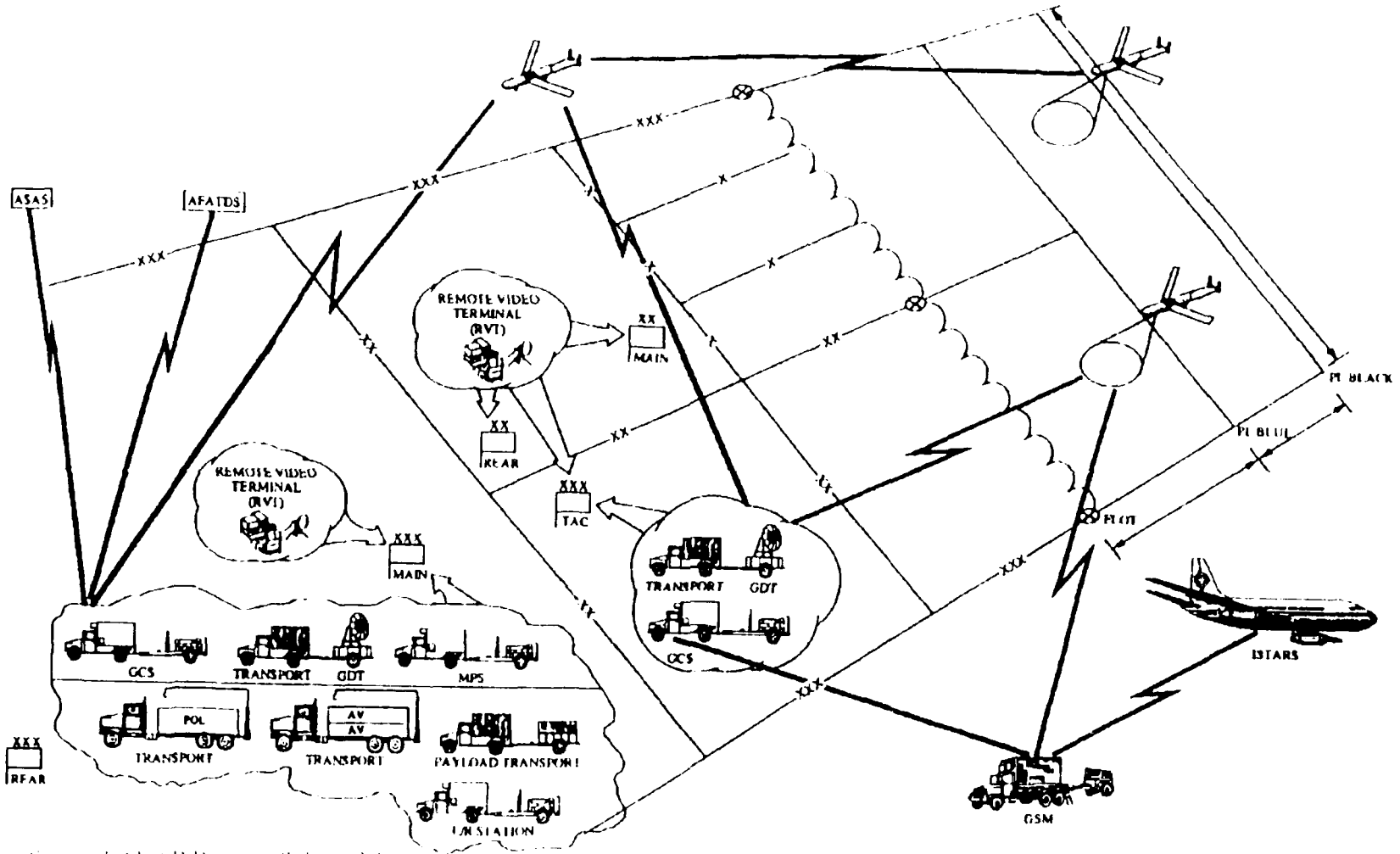
management. The SR Project Office is currently awaiting a DAB decision for Low Rate Production (LRP) approval. After the DAB, LUT II will be conducted to examine the operational suitability of the system when operated and maintained by typical military users. An Initial Operational Test and Evaluation (IOT&E) will then be conducted and used to support the full rate production (FRP) decision.

The SR system consists of a mission planning and control station (MPCS), which includes one mission planning station (MPS) and two ground control stations (GCS); remote video terminals (RVT); eight air vehicles; modular mission payloads; ground and air data terminals; launch and recovery equipment; and integrated logistics support (ILS).

The MPCS collects, processes, analyzes, and stores data and distributes battlefield information by interfacing with present and planned C^3I systems. Flight and mission commands are sent through ground data terminals to the air vehicle and modular mission payloads from the MPCS. RSTA information and air vehicle position data are sent by downlink either through airborne relays or directly to the MPCS and external receiving systems. Data are received by the MPCS and can be distributed to RVTs located in tactical operations centers. The mission capability will be enhanced as advanced mission payloads become available. A diagram of the UAV SR employment concept is depicted in Figure 6.

The objective of the SR program is to field a total of 48 systems with 27 going to the Army, 18 for the Marine Corps, and 3 for training purposes. The performance specifications for the system include:

Radius of Action	Greater than 150 km
Speed	90 knots with dash capability
Altitude	15,000 feet



(Source: UAV-SR Briefing Slides, 9 Jul 97)

Figure 6 UAV-SR Employment Concept

Sensor Type Day/Night imagery plus relay

The contractor successfully met the following Exit Criteria during the FET and the LUT:

- Launch and recovery from unimproved areas (200m x 75m)
- Flight endurance of 8 hours
- Sensor payloads resolution in accordance with specification
- Successful relay of mission data at specified ranges
- Contractor's production readiness was verified

5. Cost Effectiveness Comparisons

Several Cost and Operational Effectiveness Analyses (COEA) were conducted by the Project Office to validate the program approach and to support milestone decision reviews. Because of the variety of alternatives to the UAV-SR, two separate approaches for COEA analyses were conducted. In most cases, the UAVs were compared to manned aircraft which would usually be required to perform identical missions. In one case, an alternative approach of comparing the mission performance of other systems (such as the ATACMS) with and without UAVs was used. In each case, the UAV-SR was determined to be the most cost effective solution. The UAV-SR was clearly the most cost effective solution when compared to manned aircraft such as the F/A-18, F-16, and Army helicopters. It was also the most cost effective solution when compared to the additional ATACMS rounds that would need to be fired if the UAV capabilities were not available to provide targeting information.

A Phase II COEA also determined that the UAV-SR not only provides a uniquely needed capability on the battlefield, but also provides a unique function

within the family of UAVs. The other UAVs, manned aircraft and national intelligence assets do not provide the required imaging capabilities that the SR system provides. [Ref. 20:p. 10]

The COEA analyses also concluded that the Service unique systems in use when the UAV JPO was established did not have the essential technical growth potential, range, and other key capabilities for mission accomplishment, and therefore, were rejected as alternatives to the UAV-SR.

D. SUMMARY

The JPO has developed a successful acquisition strategy for the family of UAVs. The aspect of interoperability and commonality appears to be providing the expected benefits as envisioned in the Master Plan. However, the sense of urgency surrounding the initiation of the joint program resulted in several unique management arrangements, e.g. the establishment of the EXCOM and the funding process. These arrangements combined with the joint status of the program have led to a number of issues which have either presented the SR program with problem areas or have the potential to become problems in the future.

V. SHORT RANGE UAV ISSUES

A. INTRODUCTION

The following issues were identified through a series of interviews with key Government individuals within the UAV-SR Program Office, the UAV JPO, and with representatives of the users within the Army and Marine Corps. Comments received during the interviews were used in conjunction with the program documentation to formulate issues which impact the UAV-SR program and are a direct result of the joint status of the program. The issues identified are not necessarily problem areas for the UAV-SR but, because of the organization, structure of the program or with a change in key personnel, have the potential to become problem areas.

B. ISSUES WITHIN THE UAV-SR PROGRAM

1. Operational Requirements

In a discussion with a group of acquisition students at the Naval Postgraduate School, Rear Admiral Bill Vincent, Commandant of the Defense Systems Management College, stated that "the greatest problem with Joint Service Acquisition Programs is the correct definition of mission requirements." Anyone ever associated with a joint service program would probably agree with Admiral Vincent. The presumption that each Service has a separate and unique role in the defense of the nation has created a tendency by the Services to preserve their individual identities by any means. This tendency has often resulted in a reluctance to participate in joint Service ventures and, when

participation is unavoidable, an unwillingness to compromise on Service specific requirements.

The UAV-SR program has experienced some difficulty in solidifying its operational requirements but not solely because of the traditional reasons. The guidance from Congress to consolidate the management of all UAV programs and to proceed in an excelerated manner presented the program management with a unique opportunity. The initial organization under the EXCOM allowed the program management to streamline the normal acquisition process. Representatives of each Service were gathered together in a room and instructed to quickly develop a MNS which each Service could agree to. After a day and a half, the Services reached agreement on the MNS for the family of UAVs. In accordance with guidance received from the USD(A), the statements were short and concise (two pages). Recognizing that one of the contributing factors to the failure of the Aquila was the over specification of system requirements, the Army was satisfied with a short, simple statement of mission need. The Marine Corps also agreed to the basic mission requirements which were then validated by the JROC.

At the time, the new DOD 5000 series publications had not yet been released and the UAV-SR was classified as an ACAT II program. These circumstances combined with the flexibility the program had under the EXCOM allowed the management to delete certain non-essential requirements. As a result, an Operational Requirements Document (ORD) was not initially required for the UAV-SR nor was one prepared. The program proceeded along with the basic requirements as specified in the MNS until a Marine Corps Letter defining the Marine SR requirements was received on 17 May 1991. The Marines were

present at the initial meeting when the requirements were generated but had expected to formulate a more formal and detailed requirements document later When it became apparent to the Marines that the program was proceeding based on the broadly written MNS, the letter was drafted to quantify specific operational requirements which the Marines desired but were lacking. Since the SR system was already well into its development, the Marine requirements at this late stage were viewed as a sudden change by the Army.

In February 1991, the revised DOD 5000 series publications were implemented and prescribed new procedures and documentation requirements for acquisition programs. In January 1992, after the disestablishment of the EXCOM, the ADM resulting from the DAB review reclassified the UAV-SR as an ACAT I program. These two events now made the ORD a required document for the SR program. An ORD was written by the SR program office with input from the other Services and was finally signed in November 1992, four years after the program was initiated. The usefulness of the ORD is questionable since it was developed after the contractor and system had already been selected. Unlike most acquisition programs which use an ORD to guide and direct the program through the design and development stages, the UAV-SR used the actual system capabilities to construct the ORD.

As of the present date, each Service has been willing to accept the operational requirements of the system and no major changes to the requirements have been incorporated into the ORD. However, the process of developing and reaching agreement on the ORD was very time consuming and could have potentially adversely impacted the program. The DAB review may have been further delayed or design changes to the system may have been required had the

ORD not been satisfactory to each Service. The inflexibility of the DAB process would not allow the requirement for an ORD to be deleted for the SR even though it would have marginal utility. Although some problems arose in the requirements generation process for the UAV-SR, compared to the problems McNamara experienced with the Joint TFX program in the 1960s, they were minor. In fact, the requirements generation process for the UAV can actually be considered a strength of the program by the JPO.

The success the UAV-SR did enjoy in the requirements generation can be attributed to two factors: 1) a willingness on the part of each Service to compromise, and 2) the active role played by the JROC and the Special Study Group (SSG).

Each Service stated that the final system is not exactly what it would have procured had the program been single Service, but the compromises by all were minor. The Marines preferred a smaller system which would allow three aircraft to be transported on one 5-ton truck. They also desired a system which could clear a 15 meter obstacle in the landing zone and have a system reliability of 85%. The Army had no such requirements but compromised by agreeing to an aircraft capable of clearing a 10 meter obstacle. The other Marine requirements were dropped. The Army also compromised on the acquisition process by agreeing to change the wording or sentence structure in the ORD to satisfy procedural differences between the Services. Although the basic SR system is virtually the same as it was initially conceived, the formality of reaching a consensus on the requirements may have added an additional 90 days to the schedule according to an estimate within the project office.

The role of the SSG was important in resolving requirements related issues and providing the JROC with timely recommendations. The SSG is chaired by an Army Brigadier General and includes representatives from the other Services of equal rank. The SSG was effective in minimizing the effects of trivial differences in requirements and also in ensuring that any delays would not adversely affect the program. The JROC was also actively involved in the requirements process.

2. Budgeting and Funding

No major problems were identified in the budgeting arena but the potential exists for problems because of the unique structure within the UAV JPO. First of all, funding at the DOD level versus funding at the Service level presents a number of advantages and disadvantages. Funds are allocated in two DOD Program Elements (PE): one for RDT&E and one for Procurement. The PEO has the authority to shift funds of the same PE from one program to another within the UAV. From the perspective of the UAV-SR this ability may be perceived as a disadvantage since the SR program currently has the largest budget and any shift of funds will most likely take money away from the SR to fund other UAV programs.

The PEO may also perceive the funding arrangement as a disadvantage compared to a non-joint PEO or even the normal joint PEO. In a normal non-joint PEO, such as the PEO Tactical Missiles located at MICOM, the PEO has eight major programs and has the authority to reprogram up to $4.0M RDT&E and $10.0M Procurement funds from one program to another. With a larger number of programs, there is a greater likelihood that more than one program is in the same

stage of development and therefore there is more flexibility in reprogramming funds. In the UAV JPO, the SR program is the primary program using Procurement dollars and if a problem were to arise and procurement were delayed, funds may expire before they could be used. The funding profile for the UAV-SR compared to the total UAV JPO is depicted below.

TABLE VI. FUNDING PROFILE

	FY92 UAV JPO	FY92 UAV-SR	FY93 UAV JPO	FY93 UAV-SR
RDT&E	$ 66.9M	$ 15.2M	$129.1M	$ 31.4M
PROCUREMENT	$138.4M	$132.7M	$148.9M	$144.0M

Source: Master Plan p. 63

If the PEO were to shift funds from one program to another, the high visibility and joint status of the UAV would almost assuredly result in strong opposition from the affected Services, DOD and even Congress. As a result, the apparent flexibility the PEO would have is probably non-existent.

Another disadvantage of the funding arrangement may arise if the program encounters difficulties and requires a large amount of additional funds. While gaining additional funds for any program in a period of declining budgets is difficult, it is virtually impossible if a program does not have an advocate who will fight for scarce resources. In the case of the UAV, DOD must be the requestor

of any additional funds and therefore would play the role of an "advocate" for the program. However, DOD guidance has been to reduce the appearance of advocacy for a program and it is unlikely that DOD would reverse itself in the case of the UAV. The Services are not likely to fight as hard for funds for a joint program funded by DOD either, especially when there are funding problems within their own Service programs. The most likely alternative should a funding shortfall occur for the UAV-SR, would be to stretch the program out.

A final disadvantage with budgeting for the UAV JPO concerns the use of Operations and Maintenance (O&M) funds. O&M funds are allocated to the Services but must be used to pay for certain aspects of the UAV program which are not covered by RDT&E and Procurement funds. The Services have not shown the same commitment to using O&M funds for a joint program as they have for a single Service program. The UAV-SR program found that although each Service agreed that a Joint Training Facility for all UAVs was needed, the Services were reluctant to use their own O&M funds to help support it. The funds were eventually provided by the Army.

Most of the disadvantages concerning the budgeting for the UAV discussed in this section have not yet materialized. They are mentioned as concerns and possible problem areas but the reality within the UAV JPO is that the funding has been remarkably stable. In fact, funding has actually increased slightly during a period when many programs are experiencing cutbacks. This fact points out a possible advantage of the budget structure in that the funds are not accessible to the Services for reprogramming out of the UAVs and the perception that the biggest advocate for joint programs may, in fact, be Congress.

3. Test & Evaluation

The T&E aspects of the UAV-SR program has presented another issue area because of the joint status of the program. The testing for the UAV-SR includes DT&E and OT&E and involves personnel and test facilities of all of the Services.

The first concern of any program T&E usually centers around the Test & Evaluation Master Plan (TEMP) which is required for all ACAT I programs in accordance with DOD Instruction 5000.2. The DOD Instruction states that in a Multi-Service T&E the lead Service will prepare a single TEMP and a single T&E report on the operational effectiveness and suitability of the system for each participating Service. [Ref. 8:p. 8-7] In the case of the UAV-SR, the Army, as the lead Service, prepared the TEMP (classified SECRET). The TEMP was required to be approved by all participating Services in addition to DOD. While it is important that each participant is satisfied that the T&E will provide an adequate assessment of the program's progress, the potential exists to create an overly burdensome process as well. Each Service, along with DOD, has individual veto power over the TEMP wherein any one of the organizations may reject the entire document if it does not meet with that organization's approval. This stipulation increases the workload for the program office because it must prepare a TEMP which satisfies the separate, and sometimes unique, requirements of each Service as well as DOD. The project office must be familiar with and adhere to a separate set of rules and regulations for each agency and then incorporate all of the different requirements into a single document.

Additional problems and delays arise because each Service must approve test results prior to their acceptance. One such delay was experienced

with the Limited User Test (LUT) I which was the first evaluation of the equipment as it was operated by actual users. LUT I was completed in July 1992, however, as of November 1992 the final test report had still not yet been approved and signed off by all of the Services . Such delays can have an adverse impact on other areas of the program which may be dependent on the approval of the test results. Any unresolved issues pertaining to the LUT I, for example, could be very damaging to the program as the project office prepares for its upcoming DAB approval for LRP. The longer it takes to receive the test results and comments back from each Service, the less time the project office will have to resolve any issues.

Another area of concern for Joint programs is maintaining a perception that all participants are equally involved in the T&E process. The Navy is the lead agency for the DT&E as well as the OT&E. The Army has the Joint Training Facility as well as test facilities co-located with the project office. The Marines must provide user representatives for the test and the Air Force wants to be involved. To ensure that each Service has a "piece of the action" in the testing of the SR system, responsibilities have been divided among several different test sites. Some of the test locations which have already been used include the:

-U.S. Army Electronic Proving Ground, Ft. Huachuca, AZ

-Naval Air Warfare Center, Aircraft Division, Trenton, NJ

-Naval Air Warfare Center, Weapons Division, Pt. Mugu, CA

-Naval Air Warfare Center, Weapons Division, China Lake, CA

-U.S. Army Missile Command, Redstone Arsenal, AL

Additionally, the LUT II which is the follow-up user test is scheduled to take place at Eglin Air Force Base, Valparaiso, FL.

While using all of the test sites may provide the best combination of the required restricted airspace, ground space and sea space to conduct UAV testing, additional costs are incurred, more coordination is required, and the testing will take much more time. The cost for the LUT I was approximately $15M and the projected costs for LUT II and the IOT&E are $12M and $25M respectively. It was estimated by the project office that if the SR were a single Service program the total T&E costs could be about 50% less. Additionally, using different test sites from different Services created the need for the program office to alter the test or otherwise make provisions to ensure that the rules and regulations for each range were satisfied. The rules and range regulations varied greatly from site to site and required additional coordination between the project office and the various test facilities.

Philosophical differences between the Services also becomes a factor in the T&E of joint programs. In the UAV-SR, the Marines approach to the testing was one in which they wanted to correct all problems or deficiencies that were identified, no matter how small the problem may be. The rationale from the Marines is that they would rather fix a problem in the developmental stages of the acquisition cycle rather than rely on limited O&M funds to fix a problem once the system has been fielded. The Army is more willing to accept a system with minor deficiencies rather than delay its fielding. It has a larger O&M budget and can more easily fix minor problems even after a system has been fielded. This concern was a larger issue for the UAV-SR because of the short and somewhat broad MNS which served as the requirements document for the first four years of the program. Although the MNS provided certain advantages by not overspecifying requirements, a disadvantage of a broad statement is that it created ambiguity in

determining what standards the system should be tested to. The ambiguity of the MNS resulted in different interpretations by each Service and the test community of what the test parameters and standards should be.

Finally, since the testing was a multi-service T&E, members of more than one Service were required to conduct the testing. Although a potential for problems exists whenever an event relies on the coordination between two or more Services, the UAV-SR experienced minimal problems in this area. The LUT I required both soldiers and marines to operate the equipment and no major problems were identified. For the upcoming LUT II, the testing will be conducted with integrated platoons made up of soldiers and marines. The concept of integrated platoons was a compromise that will actually benefit both Services. The Marine Corps agreed to provide a group of marines for the testing according to normal procedures whereby marines are selected at random for assignment to the testing facility. All of the marines were inexperienced with UAVs and, if tested as a separate platoon, would require a lengthy training period. The Army wants to use experienced soldiers who could form a cadre for future UAV units and also serve as instructors on the equipment after the tests are completed. The integrated platoons meets the needs of both Services and also provides a more realistic evaluation of the users by integrating experienced and inexperienced personnel.

4. Project Office Organization

The area of Project Office organization includes not only the staffing of the UAV-SR project office but also its geographical location. The obvious question concerning the staffing of the UAV-SR project concerns the apparent lack of representation by the participating Services. The project office is staffed

totally by Army active duty and civilian personnel. The Marines were represented by a single officer for the first three years of the program but the billet has since been transferred to the newly established UAV-CR program. Since the Marines will eventually receive one third of the total SR systems fielded, their interests could be better served by better representation in the project office. The Navy, although not anticipated to receive any SR systems, has a tremendous stake in the UAV-SR program nonetheless since the SR serves as the baseline system for the entire family of UAVs. The lack of any representation by the other participating Services in the SR project office gives the impression that the program is not a high priority for the other Services. Additionally, the opportunity to apply the lessons learned from the SR program to the other UAV programs is not taken advantage of by the other Services.

The present staffing arrangement probably does give the PM greater control over his personnel since they are all from the same Service, however, it also has a downside. The entire staff at the SR office is experienced at working in Army programs and therefore is accustomed to preparing documentation and reports and following acquisition procedures in accordance with Army guidance. However, the lead Service is the Navy and as such the Navy is the approving authority for all program documentation. The Navy requires that its procedures be followed in the program management, not the Army's.

Another problem for the SR program is the geographical separation from the JPO. With the program office in Alabama and the JPO in Washington D.C., coordination between the two offices is made more difficult. The PM spends a majority of his time traveling between the two locations and thus has less time

to spend at the project office. Of course, the separation could also be a benefit in that it leads to less oversight by the JPO.

Another potential problem could result because of the geographical separation in the area of support activities. The UAV-SR must compete with all of the other programs at Redstone for matrix personnel support as well as other service support from MICOM. If resources within MICOM become scarce, programs at Redstone co-located with their PEO might have an advantage over the SR program whose PEO is located in Washington. There has been no problem with the support provided by MICOM to date.

5. Logistics

Historically, logistics has been one of the most difficult issues to resolve in joint programs. The logistics program within the UAV-SR began with the development of a joint logistics document, the JILSP. Each Service was actively involved in its development.

The UAV-SR experienced some problems in the area of logistics because of its joint status but many of the problems were a result of the acquisition of NDI systems. When a group of 60 auditors from the various Services began reviewing, analyzing and approving all aspects of the logistics program, a series of findings resulted. Problems were identified with the Human Systems Integration Plan and the Integrated Logistics Support Plan. Most of the problems were procedural in that an element of one of the plans did not conform to the customary procedures of a Service. Although time consuming, most of these differences were resolved without much trouble. However, DOD was less

cooperative. DOD auditors rejected the Human Systems Integration Plan and insisted that it be re-written to meet all DOD standards.

Most of the auditor's findings concerned the level of analysis provided by the contractor for the various components of the system. The findings addressed certain deliverable documents and analyses that are normally required of the contractor but, because many of the SR components were NDI, were not available. In most developmental programs, the level of analysis and documentation required is specified early in the program. As the contractor progresses through the developmental stages, the analysis is performed and the documentation prepared. Since the Government pays for this process, it is usually not challenged by the contractor. With an NDI system, though, the contractor has no guarantee of covering his expenses and is, therefore, less likely to conduct the costly analysis. In the case of the UAV-SR, the program maximized the use of NDI systems and as a result much of what was required by the auditors was not available. The contractors were required to recreate early developmental processes, for example, to perform reliability and quality assurance tests to satisfy the audit findings.

The program now has a single audit agency, the Logistics Review Group, which is chaired by the Navy. The Logistics Review Group has been successful in reducing the duplication of effort which existed when each Service placed separate demands on the program. The single audit now satisfies the requirements of all of the Services. The Group can also present a unified position to resolve problems which arise from DOD.

In the area of UAV training and supplies, the Army Logistics Center serves as the lead agency. Training for all Services will be integrated at one site. A

single training facility is maintained at Ft. Huachuca, Arizona. The program also plans to have a single set of publications for all Services with addendums which could be added to address any Service unique requirements. Differences in maintenance procedures between the Services will be addressed in addendums to the maintenance manuals. Some additional cost was incurred by the program in configuring the UAV interface test sets to meet differences in hardware of the existing maintenance equipment within the Services.

6. Interservice Rivalries

The final issue for the UAV-SR program involves interservice rivalries or parochial interests of the Services. Each individual interviewed mentioned this as a problem and gave several examples of how it has impacted different aspects of the program. The following are typical interservice parochialisms:

a) Mission Implications. Interservice rivalries became evident in the early stages of the program and have contributed to differences in how the Services even view the UAV program. The Army and Marines have expressed enthusiastic support from the beginning for the concept of using an unmanned aerial vehicle to supplement manned aircraft. The Navy and Air Force, however, have been more resistant to the program and see the UAV as a threat to its future manned programs. While the Army and Marines are eager to field the system, the other Services appear less so.

b) Engineering and Development. As the UAV-SR program began to progress, the Navy felt that its experience in aircraft development was far superior to that of the Army and that the program would be successful only with close supervision by the Navy experts. The Navy thus provided the program

with all of the MIL-STDs it had on aircraft development and instructed the Army to follow them. The MIL-STDs included a specification for leather seats in all aircraft. This requirement was eventually waived.

c) Acquisition Philosophy. A large part of the interservice rivalries centers on which Service has the best acquisition process. Each Service has slightly different ways of interpreting the DOD 5000 series publications and, therefore, has slightly different procedures and documentation requirements. These differences have probably been the most time consuming problems for the UAV-SR project office to work out. Most of the time the product was not changed or altered in any way but the wording in a document may have been changed to satisfy one Service or a procedure may have required a time consuming explanation of why it was done a certain way.

At the 1992 Symposium for the Monterey Chapter of the NCMA, Mr. Stephen Conver, the Assistant Secretary of the Army (Research, Development & Acquisition) characterized the acquisition process as "overly cautious and one which includes a study of every possible contingency which often overly burdens the program and leads to more delay and higher costs." Mr. Conver was not speaking of joint programs but of single Service programs in general. If his characterization is correct, what happens in a joint program is that every possible contingency is multiplied by the number of participants and the burden becomes that much greater. Mr. Conver has attempted to change this practice within the Army by placing the focus on the product instead of the process. He advocates a streamlined process to minimize the required paperwork to only that which is essential so that the product can be delivered as quickly as possible. Although Mr. Conver is not directly involved in the management of the UAV-SR program,

his philosophy is implemented as much as possible by the Army program personnel. Conflict arises, however, if the Marine Corps follows a different philosophy that is entrenched in detail and documentation. The tendency by each Service involved with the UAV-SR has been to not compromise when its process or requirements were questioned and the end result has been that the project office workload increased three-fold. The attempts by one Service to streamline the acquisition process can not work in a joint program if the program is required to satisfy the requirements and processes of each Service involved.

Each Service as well as DOD also felt that it not only had a right but a responsibility to provide oversight to the program. Again, more time was required to respond to the increased oversight. An example of how the program was affected can be illustrated in the briefing presented to the JROC. In most programs the PM is not even required to brief the JROC, but because of the visibility of the UAV, he was required to do so in this case. Although the final briefing to the JROC did use time not normally required, it was far shorter than the seven pre-briefings the PM conducted to all of the interservice agencies prior to the JROC.

d) Resource Allocations. A final, and potentially explosive issue, caused by interservice rivalries may result when the different programs within the JPO compete for scarce resources. The UAV-SR program has been acknowledged as the primary program to meet the UAV needs of the Army and Marines. The Navy SR requirements were satisfied by the currently fielded Pioneer system and the developmental Maritime program. However, problems have surfaced in fulfilling the Navy SR requirements. With the retirement of the battleships within the Navy, there is no longer a ship with a large enough area to employ a UAV

with a net retrieval system. The Navy planned to fill the void by fielding a vertical take-off and landing UAV, the VTOL. The VTOL, though, has not yet been funded. In a Joint UAV COEA update presented on 24 April 1992, using a Cost Analysis conducted by the Center for Naval Analysis, the VTOL was shown to have a cost effective edge over the present UAV-SR fixed wing aircraft [Ref 21] The interpretation of these results vary depending on one's perspective. The Army may view it as an attempt to re-configure the UAV-SR program to meet the primary needs of the Navy. Not to imply that the Center for Naval Analysis could be biased towards the Navy in conducting its COEA, the analysis was, however, based on several questionable assumptions. The biggest assumption was that speed is the critical factor. From the Navy's viewpoint, the VTOL may indeed be the best SR system for all Services, even though the program is not even at the advanced developmental stage. Regardless of which Service is correct, if the VTOL continues to lack funding, competition for development funds will certainly create a major challenge for the program office.

C. BENEFITS OF THE UAV-SR JOINT STATUS

Most of those interviewed were very quick to point out a number of problem areas and disadvantages regarding the joint status of the UAV-SR. Identifying benefits of the joint status was not quite as easy. It was generally agreed by all that the program has gained certain benefits from its joint status but that it was difficult to quantify the exact level of the benefits. The benefits listed below are the areas in which the joint status of the UAV-SR has given the program an advantage over single Service programs.

1. Funding Stability

The greatest benefit enjoyed by the UAV-SR program because of its joint status has been the stable level of funding it has experienced. During a period which has seen funds for many acquisition programs reduced, the UAV-SR has actually seen its budget increase slightly. This is undoubtedly the result of the favorable light in which the Congress and DOD view joint programs. Although DOD has refused to serve as a vocal advocate for the program, Congress seems to have filled the role nicely. RDT&E and Procurement funds were increased for both FY92 and FY93.

2. Interoperability & Commonality

Another benefit of the UAV joint status is the interoperability and commonality that the program offers. The level of commonality in the family of UAVs will allow a UAV launched from an Army system to be flown forward, to relay data to an Air Force unit and then to be handed off to the control of a Marine ground control station. This capability is invaluable as the military relies more and more on joint operations. The UAVs are also linked to other national intelligence systems such as the Joint Surveillance Target Attack Radar System, or JSTARS. In mountainous regions where the radar's view is obstructed, the UAVs can maneuver at low altitude and relay imagery back to JSTARS. [Ref. 22]

The strategy of using modules in the development of the UAV-SR also allows for easier integration of technology upgrades and the transfer of components from one system to another. Slight modifications to meet Service unique requirements are also possible by simply removing one module and replacing it with another.

3. Cost Savings

Overall cost savings is another benefit which results from the program's joint status. While it is difficult to determine exactly how much money is saved, the duplication of effort and expense that existed when there were 12 separate UAV programs within DOD has been minimized. No data are currently available on exactly what the cost savings will be, but lower unit costs will certainly result from the increased quantities in systems procured. Additionally, the use of a base system for the family of UAVs has reduced the costs associated with the various common components. The Marines, as a small Service, also benefitted from the larger budget allocated for the T&E stages of the program. The T&E budget for the UAV-SR would have been difficult to match had the program been a Marine single Service program. The T&E area also received the benefit of the experience gained by the Navy during the Pioneer program which also indirectly contributed to lower costs.

D. SUMMARY

The UAV-SR program has been impacted by issues involving the operational requirements, budgeting and funding, test and evaluation, project office organization, logistics, and interservice rivalries. The program has faced these issues in addition to the myriad of other issues which face all PMs involved with acquisition programs. While single-Service programs are certainly a great challenge, joint programs present the Program Manager with more time consuming issues which often have little or no effect on the product itself. Patience and diplomatic skill are often essential characteristics of the joint

program manager. Although these issues may be specific to the UAV-SR, many may also apply to joint programs in general.

In the view of many (especially Congress), the benefits of joint Service acquisition programs far outweigh the problems such programs might present. The apparent cost savings and benefits derived from interoperability and commonality will probably continue to lead to funding stability for joint programs. It seems very likely that joint programs will be utilized more in the future. To gain the maximum benefit from joint programs, DOD should use lessons learned from programs such as the UAV and revise the current joint acquisition process.

VI. CONCLUSION AND RECOMMENDATIONS

A. CONCLUSIONS

Joint Service acquisition programs can be an effective alternative to traditional single-Service programs as DOD struggles to continue a viable modernization strategy in the current acquisition climate. The current acquisition system, however, is very cumbersome and filled with numerous unresolved issues which discourage the greater use of joint programs. Further examination of existing joint programs, such as the UAV, could provide invaluable lessons learned to DOD by identifying possible modifications to the present joint acquisition process and thereby making joint programs a more viable alternative for the future.

Like most joint programs, the UAV has been faced with a number of issues because of its joint status. It has successfully resolved many of the issues and simply survived the others. The general attitude of those associated with the program is that, overall, the UAV-SR is a good acquisition program. The program office and the JPO are staffed with good, quality personnel. The leadership throughout the organization was unanimously identified as strong. In fact, many of the issues were not presently problem areas because of the strong leadership. The problem issues appeared to be more of a nuisance than a major threat to the program. If the UAV-SR stays on its current schedule, it will have taken approximately five years to place effective systems in the field. Such a short fielding period would be a significant feat for any program.

The UAV Joint Program demonstrates that despite the many issues which still exist, there are valid benefits to be gained in joint ventures. However, changes should be made to the joint acquisition process to fully maximize the use of joint programs. In analyzing the UAV program, it was found that there is too much variance in the management of joint Service programs. Much of the variance is a result of the ambiguous nature of the regulations for joint programs and usually leads to the problems and issues joint programs inevitably encounter.

The following are the researcher's specific conclusions to the research questions posed in Chapter I. Where applicable, reference is made to the chapters where a more detailed discussion can be found.

What are the major issues involved in the management of Joint Service programs?

The major issues involved in the management of joint Service programs are listed below and discussed in greater detail in Chapter II, Section D:

1) Early establishment of a joint charter. Quick establishment of a joint charter which clearly defines responsibilities and acts as a binding document for all participants is necessary for interservice coordination.
2) The need for strong leadership within the program. The leadership must be capable of placing the interests of the program ahead of parochial interests or personal desires.
3) Establishment of equitable management and engineering procedures within the program office. If the program management fairly represents the interests of all Services there is usually less external interference and oversight in the program.

4) Resolution of interservice conflicts and requirements. A willingness to compromise is essential for resolution of interservice conflicts and requirements. However, the need to compromise may also leave each Service feeling as though it is not receiving the exact system it actually desires.

5) Joint program oversight. Joint programs are usually of greater interest to higher authorities than single Service programs and as a result they tend to receive more oversight.

6) Joint program organization structure. Organization of the program structure should reflect the level of interest of the various Services. Some Services may feel inadequately represented in the joint program organization.

7) Logistics support. The logistics area is one of the most difficult issues to resolve in joint programs because logistics is organized and implemented differently in each Service.

8) Access to critical program data. Providing complete data and information to all interested parties is essential. Selective omission of controversial data or information provided to a Service, DOD or the Congress can severely damage the credibility of a program.

9) Lessons Learned. The joint Service acquisition process may be flawed, although review and study of the lessons learned of past joint programs can be a meaningful source for ideas and improvement.

In addition to these issues, the lessons learned from the UAV-SR are discussed below as part of the applicable subsidiary research questions. One underlying cause of each of the major issues is the presence of parochial interests and/or a general distrust among the Services. These attitudes are deep rooted in the various traditions of the Services and are not easily changed. In fact, without outside intervention, the UAV would probably still be managed through a series of single Service programs. Reducing the impact of parochial interests could be accomplished through a mutual agreement of all individuals associated with joint programs or (the more likely route) by changing the joint acquisition process to eliminate opportunities for parochialism. A recommendation for changing the process is discussed in the last subsidiary research question of this Section.

What is DOD's current policy for the Management of Joint Service Programs?

DOD's current policy for the management of joint Service programs is found in a three page section of DOD Instruction 5000.2. The Instruction provides general policies and procedures for the management of joint Service programs. It specifies the responsibilities for the lead Service and states that the joint program will have single quality assurance, change control, and integrated test programs. It is ambiguous, though, in how the joint program is to achieve these. The experience of the UAV-SR has been that these program objectives are achieved only by incorporating the different requirements of each Service into a massive, all encompassing program. Additionally, a summary of the procedures as outlined by the DSMC is contained in its Joint Logistics Commanders Guide for the Management of Joint Service Programs and summarized in Chapter II of this thesis. Although the Guide offers some very useful information on the

management of joint Service programs, it is only a guide. The fact that current DOD policy is vague allows each Service the opportunity to interpret requirements consistent with that Service's policies. As a result, a great deal of additional program time and effort is required to negotiate and resolve these parochial interpretations with little or no contribution to the end product.

Is there enough similarity among the single Service UAV programs to warrant a joint Service program?

The history of the UAV single Service programs is discussed in Chapter III of this thesis. The two primary single Service UAV programs examined are the Aquila and the Pioneer. Both aircraft were primarily designed to provide the ground or ship commander with the capability to conduct near-real-time reconnaissance and surveillance. Both were also capable of spotting for and directing indirect fire weapons. The size and in-flight capabilities of the aircraft were similar as was the launch and retrieval systems. There was no evidence of a sharing of technology or of lessons learned between the two program offices. In fact, there appeared to be an adversarial relationship between the programs. During Desert Storm there were no Aquila RPVs employed but the Pioneer provided the Army with the capabilities it desired of the Aquila. The similarities between these two systems and the present SR operational requirement of the Services does, indeed, warrant a joint Service UAV program.

What lessons can be learned from the UAV Joint Program?

The lessons that can be learned from the UAV Joint Program can best be discussed by addressing the six major SR issues identified in Chapter V. The issues identified are not all inclusive but those mentioned were addressed on more

than one occasion during the interviews. The issues are also not necessarily actual problems but rather may be areas which require more attention because the program is joint or because they have the potential to become problems. A comment that was made by each individual interviewed was that the UAV-SR program required more time in virtually all areas of program management because of its joint status. The single recurring cause was that since there was no specific procedure for joint programs, the process had to be duplicated to meet the requirements of each individual agency. In addressing the issues for the UAV-SR program, another recurring comment was that most of the issues were more of a nuisance than an obstacle. It was generally agreed that the program was progressing far better than one might expect. The program's strong leadership from the JPO down to the project office appears to be the main reason that many of the issues were not actually problems. The fact that the Army and Marines are anxious to field a system quickly has also given each Service a greater willingness to resolve minor differences.

Several of the strategies used by the UAV-SR to minimize issues could be applicable for other joint ventures as well. The modular approach used in the system design, for example, seems to offer great utility in adjusting to minor differences in Service unique requirements. The major issues identified in the SR program are:

1) Operational Requirements. Problems were experienced in the SR program in the generation of operational requirements but were eventually resolved with little adverse affect. Initially, gathering representatives of each Service and presenting them with a short deadline was effective in reaching a consensus on the MNS. The broadly written MNS may be helpful in that it did

not overspecify requirements, however, more detailed requirements could have prevented problems which arose later e.g. difficulties in identifying T&E parameters. The active involvement of the SSG and the JROC also contributed to the early resolution of problems in this area. A similar time constraint could be effective for the requirements generation of other joint programs but a slightly more detailed document such as the ORD should be the final product. Once the operational requirements are agreed to, any changes should be required to be submitted through a formal review process which could minimize trivial desires of any single Service.

2) Funding. Funding for joint programs should not be controlled at the DOD level. In the UAV program, funding should be controlled by the lead Service. This could give the UAV JPO the same flexibility with funds that other PEOs have. However, if all funding is routed through the lead Service, problems with interservice rivalries may arise.

3) Test & Evaluation. A single agency should be responsible for the T&E of joint programs. Any T&E issues should be resolved early in the program and the lead test agency should have sole responsibility and authority over the program. For the UAV-SR, the Navy is the lead T&E agency and should be the only Service with final approval authority for the TEMP and other test documentation.

4) Project Office Organization. The project office organization of a joint program should reflect the level of involvement of each Service. The UAV-SR should have more Marine representation and should have an appropriate level of representation from the Navy JPO. A joint program made up solely of individuals from one Service does not adequately represent the interests of all participants.

5) Logistics. There should be a single logistics system for joint programs. The UAV-SR could serve as a model for other programs in this area. The oversight provided by the Logistics Review Group, the single training facility, and the single set of publications are all examples of how the SR program has resolved a normally difficult issue.

6) Interservice Rivalries. Resolving the barriers which parochial interests place on joint programs can best be achieved by changing the acquisition process. A specific policy which removes all ambiguity must be implemented by an authority above the level of the Services. Such a policy should clearly delineate responsibilities and leave no room for interference from outside agencies.

What are the actual benefits of the joint status as experienced within the UAV JPO?

The actual benefits that the UAV JPO experienced as a result of the joint status of the program are in line with the generally stated benefits. The program has reduced the duplication of effort that existed previously. The total RDT&E costs for the joint program will be less than the RDT&E costs for the previous 12 separate programs within DOD. Although the exact savings are not known, the procurement costs will be decreased with a larger quantity of systems as well. In the case of a smaller Service such as the Marine Corps, a more thorough T&E is possible since they do not have to bear the sole burden of the expense.

Additionally, the benefits of interoperability and commonality appears to be a major success for the UAV JPO. The UAV is capable of interoperating with and even enhancing other national intelligence systems such as the JSTARS. The capability of a single UAV to provide data to all Services and to interoperate with

other UAV family systems is also invaluable as joint operations become a key aspect of U.S. defense strategy. The commonality in components also provides cost savings by reducing duplication of effort and by allowing for a more efficient logistics system.

Finally, and probably most importantly, the benefit of a joint program is that it is in line with the wishes of the Congress and DOD. The experience of the UAV-SR in maintaining its funding level clearly points to the favorable view the Congress and DOD have regarding joint programs.

What recommended changes to the current acquisition policy would encourage the establishment of more joint service programs and contribute to a greater likelihood of their success?

A greater emphasis on joint programs is needed at the senior levels of the Services and at DOD. In a recent speech, Senator Sam Nunn, chairman of the Senate Armed Services Committee, assailed the DOD for not making a greater effort in the joint arena [Ref. 23]. It seems evident that the Congress will continue to look more favorably on joint ventures than on single Service programs. If the Services wait until they are prodded into joint programs then they will continue to be met with limited success. The following are recommended changes to the current acquisition policy:

1) Structured Process for Joint Programs. Once a program becomes joint, the inefficiencies and duplication within the process need to be eliminated. This can only be done by establishing a more structured process for joint programs and removing the ability of individual Services to create barriers for the program. Many of the problems encountered by joint programs are created because the programs are considered no different than any other program. Each Service tries

to force the joint program into a mold of how it manages its single Service programs. The realty is that the joint program is different and therefore should be managed differently. However, there will always be a reluctance on the part of the Services to "give up" something unless the other Services reciprocate. This creates a needless cycle of negotiation that adds little to the product but delays the entire process. Mr. Conver's criticism of the tendency to place more emphasis on the process rather than the product is very appropriate in the case of joint acquisition programs.[5]

A structured, streamlined acquisition process directed from either the DOD or the JCS could alleviate the ambiguity in the current procedures. Specific guidance should be given as to which documentation and procedures will be followed in joint programs. One option could specify the exclusive use of the procedures of the lead Service. Another option could be to develop a separate and unique procedure for joint programs. This option would allow the selection and use of the best procedures currently implemented by the various Services. If no such procedures are available for a particular aspect of the program, they could be developed rather than simply relying on outdated procedures.

2) Organization. In the case of joint program organization, the options should be limited to a select few rather than the multitude currently available. The joint program office could be organized with a lead Service as with the UAV or with an oversight group which could report to the JCS. The lead Service organization could be appropriate in cases where one Service has an overriding interest in a system. The lead Service method, however, will not resolve all problems with Service parochialisms. A centralized management organization

[5] 1992 Symposium for the Monterey Chapter of the NCMA, 6 November 1992.

similar to the Special Study Group (SSG) within the UAV program may offer the best solution in cases where several Services have equal interests in a program. The SSG could be made up of representatives of each Service and report directly to the JROC. The JROC would be responsible for all joint programs. Ideally, a series of SSGs could provide a similar function for joint programs as the current PEO structure provides for the Services. The joint programs could be organized according to similar missions or system types. For example, the UAVs would be grouped with other national intelligence gathering systems. A group that presently exists such as the Conventional Systems Committee could serve as the SSG for a group of similar joint programs. The chairman of the JROC could serve in a similar capacity as the Service Acquisition Executives for all joint programs.

3) Funding. Funding could be directed through the JROC to the SSG down to the specific programs. This would allow for a certain amount of flexibility in reprogramming funds and negate the appearance of parochialism that may presently exist. The SSG or the JROC would also be in a better position than DOD to serve as an "advocate" for a program or at least make a judgement concerning program priorities. Funding should not be left to the discretion of the Services once a commitment has been made to initiate a joint program. The creation of special funding arrangements as with the UAV (through DOD) should not be continued due to the inflexibility of reprogramming of funds.

4) Use Existing Acquisition Agencies. The centralized management of joint Service programs should not require the establishment of new acquisition agencies. The SSG should have the authority to bid for the services of agencies which presently exist. As in the case of the UAV, the SSG could contract with the Army Logistics Center for all logistics related concerns of a program. Or it may

chose to appoint the Navy to provide all audit services as the UAV-SR program did. The problems with joint programs do not appear to be a result of separating responsibilities among different agencies but more a function of not doing so and therefore allowing each agency of each Service to create a role for itself.

B. SUMMARY OF RECOMMENDATIONS

The answers to the research questions above include numerous recommendations to improve the UAV-SR program as well as the current joint acquisition process. The recommendations require change in two major areas of the current structure. First, is to change to the current process. The joint acquisition process should be simplified and the priority must shift from the process to the product. The present process burdens the joint program with duplication and unnecessary requirements. If the process remains cumbersome, the Services will continue to be reluctant to initiate more joint ventures. Second, is to create an organizational structure which minimizes the affects of parochialism. Responsibility for joint programs should be clearly defined with a single chain of command. Appropriate authority should be given to a centralized management structure to reduce the impact of agencies external to the program.

The following is a summary of the previously discussed specific recommendations which apply to the SR program as well as to joint programs in general:

1) A structured process specifically for joint Service acquisition programs should be created.
2) A centralized joint program management organization should be formed.

3) A standard means of funding joint programs should be implemented.

4) The joint program management should have the authority to bid for and appoint lead agencies for program support.

5) The joint requirements document should be developed and agreed to early in the program and changes should be limited to only those which are viewed as critical by all participants.

6) A single T&E agency should be appointed and have sole responsibility and final approval authority for test matters.

7) The joint program office organization should be representative of the level of interest of all participating Services.

8) A single logistics system should be established in joint programs.

9) Changes should be made to the structure and process of joint Service acquisition programs to minimize the affects of parochialism.

C. AREAS FOR FURTHER RESEARCH

This thesis examined only one specific program within one JPO and generalized conclusions and recommendations which could be applicable to joint programs in general. Areas of further research include:

1) An examination of other joint programs which are organized differently than the UAV should be conducted to determine if similar issues exist.

2) An organizational model should be designed and developed for the express purpose of managing joint programs. This approach could involve a comparative analysis of existing joint programs or programs with joint potential and the grouping of these programs into a SSG JROC type of organization. This study could also identify the feasibility and procedural requirements which might

be required in order to allow for major changes such as funding through the JROC.

APPENDIX

INDIVIDUALS INTERVIEWED

-- Deputy Project Manager
Army Unmanned Aerial Vehicles, Short Range
Redstone Arsenal, Alabama
Interview Granted: 23 October 1992

-- UAV Team Member
U.S. Army Intelligence Center and School
ATTN: ATSI-TSM-UAV
Fort Huachuca, Arizona
Interview Granted: 2 November 1992

-- UAV Team Member
USMC UAV Requirements Team
Marine Corps Systems Command
Quantico, Virginia
Interview Granted: 2 November 1992

-- Director UAV JPO & Deputy PEO (CU)
UAV Joint Program
Washington, D.C.
Interview Granted: 17 November 1992

-- Lead Program Analyst
Army Unmanned Aerial Vehicles, Short Range
Redstone Arsenal, Alabama
Interview Granted: 18 November 1992

-- Lead Engineer (also served in Requirements Office)
Army Unmanned Aerial Vehicles, Short Range
Redstone Arsenal, Alabama
Interview Granted: 18 November 1992

-- Chief, Systems Support Division
Army Unmanned Aerial Vehicles, Short Range
Redstone Arsenal, Alabama
Interview Granted: 18 November 1992

-- Project Manager
Army Unmanned Aerial Vehicles, Short Range
Redstone Arsenal, Alabama
Interview Granted: 20 November 1992

REFERENCES

1. *Program Manager's Guide*, p. 3-8, Naval Postgraduate School class text, September 1990.

2. DOD Directive 5000.1, *Defense Acquisition*, p. 1-3, 23 February 1991.

3. Fox, J. Ronald and Field, James L., *The Defense Management Challenge*, pp. 11-20, Harvard Business School Press, Boston, MA., 1988.

4. Roherty, James M., *Decisions of Robert S. McNamara*, p 67, University of Miami Press, Coral Gables, FL., 1970.

5. Kaufmann, William W., *The McNamara Strategy*, pp. 245-250, Harper & Row, New York, NY., 1964.

6. The Defense Systems Management College, *Joint Logistics Commanders Guide For The Management Of Joint Service Programs*, 3d ed., Fort Belvoir, VA., 1987.

7. GAO Report, *Joint Military System Acquisition By The Military Services: An Elusive Strategy*, (Report NSIAD-84-22), p.12, U.S. General Accounting Office, 23 December 1983.

8. DOD Instruction 5000.2, *Defense Acquisition Management Policies and Procedures*, 23 February 1991.

9. 20/20 ABC Television News Show, "Another Gold-Plated Fiasco," Journal Graphics, 13 February 1986.

10. GAO Report, *Aquila Remotely Piloted Vehicle: Recent Developments and Alternatives*, U.S. General Accounting Office, January 1986.

11. GAO Report, *Aquila Remotely Piloted Vehicle: Its Potential Battlefield Contribution Still in Doubt*, U.S. General Accounting Office, October 1987.

12. *Unmanned Aerial Vehicle/Remotely Piloted Vehicle Information Paper*, Office of Congressman Dave McCurdy, D. OK., 11 February 1988.

13. Congressional Records, House Armed Services Papers, "Authorization and Oversight Hearings on DOD Authorization and Appropriations for FY 87," March 1986.

14. Congressional Records. "Appropriations Committee Hearings for DOD Appropriations for FY 86." March 1985.

15. DOD Unmanned Aerial Vehicles Joint Project Office. Unclassified. *Unmanned Aerial Vehicles (UAV) Master Plan 1992*. 15 April 1992.

16. "Unmanned Aerial Vehicle Support." *Military Review*. pp. 44-49. August 1989.

17. Office of the Chairman. Joint Chiefs of Staff. Unclassified Final Draft. Joint Pub 3-55.1. *Joint Tactics, Techniques and Procedures for Unmanned Aerial Vehicles (UAV)*. p. II-1. 1 October 1991.

18. "Program Executive Officer-Cruise Missiles Project and Unmanned Aerial Vehicles Joint Project." *Army Research, Development & Acquisition Bulletin*. p. 28. September-October 1992.

19. Under Secretary of Defense (Acquisition) Unclassified Memorandum. Subject: Unmanned Aerial Vehicles Acquisition Decision Memorandum. 3 January 1992.

20. DOD Unmanned Aerial Vehicles Joint Project Office-Short Range. Unclassified Draft. *Integrated Program Summary (UAV-SR)*. 9 April 1992.

21. Kusek. Leonard J., *Short-Range/Medium Range UAV COEA Cost Analysis*,Center for Naval Analyses. Alexandria. VA., October 1991.

22. McIntire. Katherine. "What Every Commander Will Want: A UAV." *Army Times*. p. 14. 30 November 1992.

23. Gelb. Leslie H., "End Costly Interservice Rivalries." *The Monterey County Herald*. p. 9A. 28 July 1992.

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